THURSDAY, SEPTEMBER 15, 1898.

ORCHIDS OF THE SIKKIM HIMALAYA.

Annals of the Royal Botanic Garden, Calcutta. Vol. viii. *The Orchids of the Sikkim Himalaya.* By Sir George King and Robert Pantling. Part I. Letterpress; II. Plates of the Malaxideæ; III. Plates of the Epidendreæ and Vandeæ; IV. Plates of the Listereæ, Goodyereæ, Ophrydeæ, and Cypripediæ. Pp. iv + 11 + 342 4to. (Calcutta: Printed at the Bengal Secretarial Press, 1898.)

THE publication of vol. viii. of the "Annals of the Royal Botanic Garden, Calcutta," makes a valuable contribution to our knowledge of the orchids indigenous to the Eastern Himalaya. It bears the title of "The Orchids of the Sikkim Himalaya," and its authors are Sir George King, K.C.I.E., F.R.S., the distinguished Director of the Royal Botanic Garden, Calcutta, and Mr. George Pantling, Deputy Superintendent of the Government Cinchona Plantation, Sikkim. The many obligations under which the former has placed botanists are well known, but the name of Mr. Pantling is new to orchidology. To the value of his services Sir George King bears emphatic testimony, and he will doubtless make himself a name in Indian botany. The circumstances under which this work have been produced are interesting. Mr. Pantling's position in Sikkim gave him opportunities of which he has taken full advantage. He sent a small party of trained native (Lepcha) collectors into the ranges between the valley of the "Great Rungeet" river and the higher snows during the hot and rainy seasons of several successive years.

"These men were provided with a few swift coolies, by whom living plants of every species collected were quickly conveyed to Mr. Pantling, who, while the plants were still fresh, made drawings of them. . . . These Lepcha collectors, as the following pages show, discovered a considerable number of species formerly unknown."

As an additional precaution the native collectors were provided with a stock of *Formaldehyd*, in a weak solution of which "excellent medium" inflorescences of every species collected were preserved. Three hundred copies of the book have been printed; in half of them the lithographs are lightly printed, and the flowers and analyses coloured; in the other half, the lithographs are darkly shaded and uncoloured.

"The drawings have all been put on stone by natives of Bengal educated at the Government School of Art in Calcutta. And the colouring has, under very careful supervision on Mr. Pantling's part, been done by the sons of Nepaulese coolies employed on the Government Cinchona Plantations—boys who had never, until Mr. Pantling took them in hand, been accustomed to use any implement more delicate than a hoe. Mr. Pantling's perseverance and skill in drilling these boys into accurate colourists has been a standing marvel to everybody who has seen them at work."

In the "Introduction" Sir George King discusses two questions, upon one of which he finds himself at variance with the highest authorities, as well as with his collaborator, Mr. Pantling. Messrs. Darwin, Bentham and Hooker, Bolus, Rolfe, Pfitzer and Krantzlin, following Robert Brown and Lindley, consider that the stamen is single in the genera Orchis, Habenaria, Herminium, Diplomeris, and Satyrium, belonging to the Ophrydeæ. Sir George has satisfied himself that in the Sikkim Ophrydeæ this is not so, and that these have two anthers, one cell of each being fertile, the other infertile.

The other question is one of classification, as to which Sir George and Mr. Pantling are in agreement. They would (*a*) restore Lindley's tribe Malaxideæ, which has recently been merged in Epidendreæ; (*b*) re-include in the Vandeæ a few specified genera which have lately been added to the Epidendreæ; and (*c*) break up Neottiæ into two tribes, Listereæ and Goodyereæ. It is further stated in the introduction that—

"Our study of the Sikkim species convinces us that the fertilisation of orchids by insect agency is by no means so universal as is sometimes supposed."

This is corroborated by the occasional self-fertilisation of cultivated plants, among them one specially mentioned by our authors, *Dendrobium crepidatum*. In regard to orchid classification numerous changes have of recent years recommended themselves to botanists, who have, for example, transferred to Miltonia from Odontoglossum the large-lipped section of plants to which *M. vexillaria*, *Roezlii*, *phalænopsis*, *Warscewiczii*, &c., belong.

The letterpress of vol. viii. of the "Annals" extends to 342 large quarto pages, the plates number 448, and there are indices both to text and plates. A full and clear botanical description of every plant figured is given in English, with its habitat, height above the sea, season of flowering, general characteristics, and distribution elsewhere than in the Sikkim Himalaya. In the coloured copies, coloured flowers and other parts of every species described are given, accompanied by botanical details, coloured and enlarged.

In looking through this work, any one acquainted with cultivated orchids can hardly fail to be struck with the large number of interesting plants it contains which are not to be met with in cultivation, even in the most extensive collections—and also with the not inconsiderable number for the first time described and figured therein. If the labours of the authors suffice to bring home to collectors of orchids the fact that many of the small-flowered genera are as beautiful and interesting as the large, they would produce good fruit. Of the genus Cirrhopetalum alone there are numerous species than which it would be difficult to find any orchid with more beautiful, fantastic and striking flowers, *e.g. C. Medusæ*, *C. picturatum*, *C. ornatissimum*, *C. Cumingi*, *C. O'Brienianum*, *C. Mastersianum*, and others. In referring to this genus it may be noted that the remarkable Cirrhopetalum, represented in pl. 133, is not *C. ornatissimum*, which has a whorled umbel and not a solitary flower, and has been figured in the *Botanical Magazine*, t. 7229, and elsewhere, its near Burmese ally, *C. Collettii*, having been figured, t. 7198, in the same work. The species figured in pl. 133 was recently sent to Kew, but was not identified. If it has not been authoritatively named, it might well be dedicated to Sir George King, and bear his name.

Of the genus Dendrobium thirty-six species are figured, and of these some twenty-four are, or have been, in

cultivation. Among them is *D. nobile*, which, being beautiful and of easy growth, is universally cultivated. It was introduced from China about sixty years ago, and has been figured many times.

Mr. Pantling's Nepaulese lads have done so well that it is hardly gracious to find fault with them. But the figures of the more showy Dendrobia illustrate a defect which detracts somewhat from the artistic value of some of the plates. The defect referred to is a want of brilliancy of colour—the tints are too sober. This may be due to the colour wash being too thin, having regard to the lithographic drawing it has to cover.

Plate 285 represents the small local form of *Vauda teres*. This plant, one of the most beautiful of the Orchideæ, produces, as found in cultivation, flowers fully twice the size. *V. teres* crossed with its near Malayan ally, *V. Hookeri*, has produced *V.* "*Agnes Joachim*," which carries a 12 to 16-flowered raceme.

Plate 445 represents, growing on a stone, a very striking orchid, *Diplomeris hirsuta*, which, besides its remarkable mode of growth and beautiful flower, is of great botanical interest, as in it "is indicated with comparative clearness a theory of the structure of the flower of the Ophrydeæ," explained in the Introduction.

Sir George King is so eminent a botanist and so high an authority on the Orchideæ that his conclusions will doubtless meet with general acceptance. Yet it is somewhat difficult to accept the view that *Dendrobium Jenkinsi*, Wallich, pl. 85, is not a good species. Under cultivation it differs widely from *D. aggregatum* in bulb, mode of growth, and inflorescence. The sub-genus Pleione is merged in Cœlogyne, but the Pleiones seem sufficiently distinct in bulb and leaf habit, and flower, fully to justify the retention of the sub-genus. Again, it would appear to be intended to merge *Thunia* in *Phaius*, from which it differs in having no pseudo-bulbs, but leafy stems with a terminal inflorescence. *Phaius albus*, pl. 153, seems to be *Thunia Marshalliana*, Rchb. f., which, when gathered on oaks in the Kangra valley at an elevation of 4000 to 5000 feet, flowered profusely in a verandah at Dharmsala.

It should be mentioned that this volume is dedicated to our great botanist, Sir Joseph Hooker. It forms a valuable contribution to the botany of the natural order it deals with, and reflects great credit on the care, skill, energy and enterprise of its authors. Moreover, the careful notes at the end of each botanical description are a useful help to the cultivator.

OUR BOOK SHELF.

Essai sur la Théorie des Machines electriques à Influence. By V. Schaffers. Pp. 139. (Paris: Gauthier-Villars et Fils. Brussels: Polleunis and Ceuterick, 1898.)

THIS is an important monograph on the history and theory of the influence electrical machine. It is now a good deal more than a century since Wilke invented the electrophorus; the apparatus was improved by Volta, and in 1786 the principle was utilised by Bennet in the "doubler." There confusion begins: machines are rediscovered, re-improved, re-named; and men of science of all nationalities make claims for the rights of priority. The author maintains his opinions unbiassed through all these historical predicaments, and deals equally fairly with Holtz, Voss, and Wimshurst. The theory of the two generic types of influence machines is dealt with at considerable length, and some account is given of the "water-dropping" apparatus, and its application to cloud formation. This part of the subject might with advantage be extended to include the beautiful experiments of Lord Rayleigh on the electrification of liquid jets.

An Introductory Course of Practical Magnetism and Electricity. By J. Reginald Ashworth, B.Sc. (Vict.). Pp. xii + 84. (London: Whittaker and Co., 1898).

IF testimony were needed of the increasing recognition of experimental work in physics as a valuable factor in education, it would be found in the large number of text-books recently published for the use of students in physical laboratories. The present manual comprises a series of practical exercises, by the performance of which the young student will add to his stock of real knowledge, and qualify himself to carry on more difficult experiments when he advances to the higher stages of his subject. The book is intended for use in the laboratory, the course in it being supplementary to the theoretical teaching of the class-room and class-book. The experiments cover the subjects of the elementary stage of magnetism and electricity of the Science and Art Department; they are concisely described, and can be successfully done with simple and inexpensive apparatus. These characteristics are sufficient to commend the volume to the attention of teachers in technical and other schools.

Photography Annual: a Compendium of Photographic Information, with a Record of Progress in Photography for the past Year. Henry Sturmey, editor. Pp. cxlvi + 722. (London: Iliffe, Sons, and Sturmey, Ltd., 1898.)

TO the photographer, be he professional or amateur, who desires to keep in touch with the progress of the science and art of photography, and to know what novelties there are in the market, this volume is almost indispensable. It contains tables of reference and other useful information for photographers; a list of photographic societies; selected articles upon practical subjects by experienced photographers; a record of progress in the various branches of the science and practice of photography during the year 1897 (including photographic chemistry), photographic optics, astronomical photography, photographic mechanical printing, and other applications of photography (including Röntgen photography). Each of these articles is a very valuable summary of scientific work published last year upon subjects related to photography, and results obtained by the aid of photography. In addition to these serviceable abstracts, the volume contains notes on novelties in photographic apparatus and materials, optical lanterns and related appliances, and several excellent specimens of process work as illustrations.

Botanisches Bilderbuch für Jung und Alt. By Franz Bley. Part ii. With explanatory text by H. Berdrow. Pp. viii + 192. 24 Plates. (Berlin: Gustav Schmidt (formerly Robert Oppenheim), 1898.)

THE first part of this work, containing coloured pictures of plants obtainable in Germany during the opening half of the year, has already been noticed in these columns; the present part contains 216 pictures upon 24 plates arranged in the order of the months in which the plants appear, from June to September. The pictures are in most cases well coloured, and, in conjunction with the explanatory notes referring to them, will assist and encourage the study of outdoor botany.

LETTERS TO THE EDITOR

The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*]

Flow of Water Shown by Colour Bands.

I SHALL be obliged if you will publish, as soon as possible, the enclosed correspondence under the heading given above.

OSBORNE REYNOLDS.

28 Marine Terrace, Criccieth, N.W.

COPY.

September 2, 1898.

DEAR OSBORNE REYNOLDS.—I do not know whether you are going to the British Association at Bristol. In any case you may like to have the enclosed.

I am just re-reading the Royal Institution discourse you were kind enough to send me some time ago, and from several things I see in it, I am sure you would like to see Prof. Stokes' proof, especially in view of the doubt you had at one time as to the distance at which viscosity would dominate the flow.

I enclose a photograph which will give you an idea of the sort of effects obtained with glycerine.

Yours truly,

Prof. Osborne Reynolds, F.R.S. H. S. HELE-SHAW.

DEAR PROF. HELE-SHAW,—I have to thank you for your letter of the second inst., and the copy of Sir George Gabriel Stokes' paper "On the viscous flow between parallel surfaces."

I think it was in June 1896 that you asked me to show you the appliances and experiments, which I have introduced during the last twenty-five years, for studying and demonstrating the manners of motion of water by the method of colour bands, which I introduced in 1875, in order that you might have similar demonstrations introduced at University College, to which request I had great pleasure in responding as far as your time would allow. I was glad when I heard shortly afterwards from you that you had already begun experimenting, and I had great pleasure in furnishing (you with copies and references to all my publications bearing on the subject, as well as any verbal information I could give you in several interviews. When, however, you sent me a copy of a paper you proposed to read, and subsequently read, before the Institution of Naval Architects, being deeply engaged in other work, I felt it necessary to put it aside, and this I did with less reluctance as I felt that any criticism suggested by experience would tend to discourage rather than to encourage you in your work, which reason I gave shortly afterwards on your pressing me for an opinion, and in this opinion I remained until this last summer, when the widely published and striking photographs were brought before me in so many ways as to force my attention in spite of my reluctance.

I then apprehended for the first time the method you had employed as described in your first paper, and the conclusion you had formed from results you had obtained by this method; which conclusion, I see from your last letter, you still maintain, namely, that with water in sinuous motion and air bubbles as indices of the manner of motion, the light bands adjacent to the surfaces of the solids, which show absence of bubbles adjacent to the solid, prove that the, once air charged, water has not been carried by sinuous motion sufficiently near to the solid surface to displace the initially adjacent water; and hence prove that the sinuous motion does not extend up to the solid surface.

With this conclusion I am entirely unable to agree for reasons which are as follows:—

(1) The photographs show that the air-clear bands adjacent to the solid surfaces are in a sense permanent; that is to say, these bands do not get thinner and ultimately vanish as the experiment is continued even when the solid surface is discontinuous fore and aft, and that the light bands on the sides of the object are thicker at the bows than at the stern, which facts cannot be explained by the maintenance of initial water, for when water meets the bow of a solid, over the surface of which it flows, no matter how slow and steady the current, the water initially at any point near the surface will be drifted back parallel to the surface with a velocity, if the motion is not sinuous, diminishing to nothing at the surface. As, then, at the bow, there is no water which has been initially adjacent to the surface available to replace that which is swept back, the bow first becomes cleared of initial water. Then as the supply of initially adjacent water swept back from the bow to replace that swept back further along diminishes, the thickness of the initial layer becomes taper from nothing at the bow to the original thickness at the stern, and then, if the experiment continues steadily, thins down till it becomes indefinitely thin.

This is an experimental result which I have demonstrated many times since first doing so before Section A at the Glasgow meeting, 1876. All that is necessary is to surround a solid object in a tank of clean water with coloured water, so that the surface of the solid is coated with a sufficiently thin coat of coloured water of the same density as the clear water, and thus keeping the solid fixed, causes the water to flow uniformly through the tank, when, if the velocity is below the critical velocity, the gradual waste of the colour, commencing at the bows, will at once be apparent, at rates proportional to the velocity of flow, which may be such it takes seconds or many minutes for the colour to disappear from the surface.

In this experiment, if the velocity of flow be above the critical velocity so that the motion is sinuous, the manner of removal of the colour is very different, and the rate of removal indefinitely enhanced, so that it seems as though it had been removed with a rough brush. It is thus seen that the maintenance of a layer of any finite thickness on the surface of a discontinuous solid over which water is flowing is contrary to well-established experience, and hence cannot account for the clear bows observed in the photographs of the experiments with air.

While the manner of the removal of the colour from the surface when the motion is sinuous proves that the sinuous motion does extend up to the solid surface.

(2) The use of air bubbles for the purpose of indicating the lines of fluid motion is setting aside the most elementary precautions. Unless the indicating body, whether solid or liquid, is of the same density as the fluid, the motion of which has to be examined, although it will drift with the fluid, will besides this motion of drift have a proper motion of its own through the fluid, which may be simply that resulting from gravitation, as in the case of a fluid in steady uniform motion, but which, in the case of a fluid of more irregular motion, will also result from the varying pressure in the fluid owing to its varying motion. This varying motion impressed on the body by the drift of the fluid causing it to move towards the higher pressure if denser than the fluid, and if lighter towards the lower pressure. Now, air bubbles form about the lightest bodies possible, and are thus those best calculated, by their motion through the fluid across the lines of motion, to seek out and indicate the positions at which the pressure in the fluid are least. In this way they have performed a very useful part in the study of fluid motion. It was from the observation of the behaviour of air bubbles in the wake of a vane moving obliquely through water that I was enabled to study the action of the screws of steamships, and to determine the cause of their racing. A most emphatic part they have played is that of indicating the line of minimum pressure in a vortex or vortex ring in water—a part which was, I feel sure, emphasised in the demonstration I gave at the College.

It is thus seen, that while air bubbles are the most misleading bodies that can be possibly chosen to indicate the lines of motion in a fluid in sinuous motion, they are the very best to indicate the lines and surfaces of mininum pressure, and by their absence to indicate the positions in which pressure is greatest. Whence it naturally follows that when the bubbles introduced in a sinuous stream of fluid shun any specific positions in the fluid, whatever may be the cause, the pressure in those parts are greater than the pressures in the immediately surrounding parts.

Thus the conclusion to be drawn from the general existence of light-bands adjacent to the solid surface over which the fluid is flowing, as shown in the photographs, in sinuous motion would, if there were no other proof of it, be that they afford evidence that the pressure of water at the solid boundaries of water in sinuous motion is a maximum, and diminishes rapidly with the distance from the surface. As it is, however, it must stand as an interesting verification of a well-established deduction from the laws of motion. For although probably but little known, the existence of this maximum pressure at the boundaries of fluid in sinuous motion, is one of the most direct conclusions from the laws of motion, as I have shown in my paper on the dynamical theory of a viscous fluid (*Phil. Trans. R.S.*, 1895, p. 142).

We have only to consider a narrow band of fluid adjacent to the surface which may be considered flat; the mean motion is in the direction of the surface, and the fluid is in mean equilibrium in direction perpendicular to the surface.

Taking u for the mean flow, and w for the relative motion perpendicular to the surface.

Then, by the laws of motion, we have, ρ being the density if z is distance from the surface, $\frac{d}{dz}(p + \rho w^2) = 0$.

Now w^2 is the square of the normal component of sinuous motion, which rapidly increases from zero at the surface, hence the fall of pressure from the surface is measured by the rate of increase of ρw^2.

With this interpretation the facts shown by the light bands adjacent to the solid, afford not only a very interesting verification, but also an instructive addition to the methods of demonstrating the actions in fluid.

With respect to the photographs with the air, as indicating the character of sinuous flow; these, I think, are entirely confused by the motion of the air through the water, and are far inferior to what has been obtained with colour bands of equal density.

The more recent of your experiments (made after my method of colour bands) are in many respects similar to those which I exhibited with the lantern first at the Royal Institution in a Friday evening lecture "On the two manners of motion of water" in 1884, and which I have since elaborated for demonstration in the College. They are strictly conformable to the theory of the motion of viscous fluids as given in the papers on the Theory of Lubrication (*Phil. Trans. R.S.*, 1886, part i.), and on the Theory of Viscous Fluids, already referred to. But although I had applied the theory to the flow of fluids between parallel surfaces very close together, I had not studied the flow between such surfaces round obstructions, and it was with much interest that I saw the beautiful photographs of the stream lines, realising as I did at once that the velocities must have been so small compared with the critical velocities that the inertia was of no account, so that the pressure would vary only along the lines of flow, while since the surfaces were parallel, p being pressure, u and v mean component velocities, $\frac{dp}{dx} = -cu$, $\frac{dp}{dy} = -cv$, and hence p became the potential function of the mean flow which, therefore, corresponded (geographically but not dynamically) to the ideal flow of a perfect fluid. (The same explanation of this coincidence is given in the copy of Sir George Stokes' paper). The coincidence is theoretically interesting. But as the domination of the effects of inertia by viscosity in the experiments is only obtained by reducing the mean velocity far below the critical value, the results cannot imply any such domination beyond that which breaks down when the critical value is reached, and therefore cannot imply any finite layer of fluid not subjected in some degree to sinuous motion. Yours truly, OSBORNE REYNOLDS.

Prof. Hele Shaw.

September 4.

Magnetic Storm.

IN view more especially of the present sitting of the International Conference on Terrestrial Magnetism at Bristol, it is of interest to note the occurrence of a fairly sharp magnetic storm on the afternoon and evening of Friday, September 9. It was associated presumably with the aurora simultaneously seen in England.

On the night of September 2 and morning of September 3 there was a very appreciable though much smaller disturbance; but subsequent to that the magnetic curves were quiet, especially so on the 6th, 7th, and morning of the 8th. The principal disturbance commenced somewhat gradually about noon on the 9th; but one of its most striking features, as recorded at Kew Observatory, was an exceptionally rapid fall occurring simultaneously, at 3.5 p.m., in the horizontal and vertical forces and in the westerly declination. The fall was so rapid as to be shown somewhat indistinctly on the photographic traces; but it amounted to at least 15′ in the declination, and ·0023 C.G.S. units in the horizontal force. The recovery from this fall was also rapid.

The declination needle between 5.15 p.m. and 8.8 p.m. receded 54′ to the east, then turned, and in the course of the next 32 minutes moved 59′ to the west.

The horizontal force attained its extreme maximum and minimum at 2.42 p.m. and 8.30 p.m. respectively, the range amounting to ·0050 C.G.S. units (or about 1/37 of the whole component). Between 7.30 and 8.30 p.m. this element fell ·0036 C.G.S. units. The vertical force reached its maximum about 6 p.m. and its minimum *about* 8.30; but as the trace unfortunately got off the sheet near the minimum, one can only say that the range of vertical force exceeded ·0036 C.G.S. units.

The curves had become fairly quiet by midnight of the 9th; but there was a recrudescence of the disturbance between 8 a.m. and midnight of the 10th, and subsequent smaller movements occurred on the 11th. CHARLES CHREE.

Kew Observatory, September 12.

Lilienfeld's Synthesis.

THE interesting article in your issue of August 18, signed by Dr. Sidney Williamson, ably summarises the position of affairs as regards the various attempts that have been made towards the synthesis of proteids. There is one point, however, which may possibly require modification. Dr. Williamson states "Such colour tests as Millon's, nitric acid, &c., have no real value; the colour developed *may* be due to the proteid molecule as a whole, but more probably to some decomposition product, and, as already mentioned, some colloids which bear no relation to actual proteids give reactions considered characteristic of these substances."

Having devoted considerable attention to the colour reactions of proteids and their derivates, I may state that there is every probability that all the colour reactions are due to disintegration of the proteid molecule during the reaction. Full details of this work will be found in a paper I published in the *Journal of Physiology* in 1894. There are ten more or less trustworthy colour reactions given by proteids, and I am unaware of any colloid that is not related to a proteid which will give more than two of these reactions, and there is at present no known colloidal substance which will produce the intravascular coagulation of the blood, except the substances synthesised by Grimaux and myself, and nucleo-proteids derived from the animal organism.

Although some of the substances I have synthesised give all the colour reactions of proteids, I do not think they are proteids; indeed, they are probably far from it, and until an absolutely trustworthy test for a proteid is discovered, and the molecular constitution of albumen is known, it is premature to assert that any synthesised substance is a proteid. To show the fallacy of relying solely on colour reactions, I may mention that a mixture of tyrosine, indol, and biuret will give all the colour tests considered diagnostic of proteids. There is little doubt that Lilienfeld's substance is an addition to those already made by Schützenberger, Grimaux, and myself, but for the reasons above stated I do not think there is any trustworthy evidence that it is actually pepton.

Sandridge, Eltham, Kent. JOHN W. PICKERING.

Larvæ in Antelope Horns.

I AM much interested in the article upon horn-feeding larvæ which appears in the last number of NATURE, just received by me (June 9).

It may interest your readers to have additional assurance that the *living* horns are attacked and infested with the larvæ in question, for cocoons and pupæ have been extracted from such horns within an hour or two of the killing of the animal owning them. This I am able to state on the unimpeachable authority of an officer who made the observation.

I myself have removed the cocoons and empty pupa cases, half extended from the orifice of the burrow in the horn; but the horns so affected had been dead for some weeks; and I have not, so far, had the opportunity of examining freshly killed specimens, nor of seeing the living larvæ.

I enclose a few of the empty cocoons and pupa cases, extracted by me from the diseased horns—for a disease it must be considered—from the antelope's point of view!

Lagos, July 22. HENRY STRACHAN.

THIS letter is of unusual interest, as it now clears up a point which has been long in doubt. In my article to NATURE which appeared on June 9 last, I gave a short account of the habits of horn-feeding larvæ, and since that time, having obtained additional notes, I beg to submit the following remarks. I have carefully examined the cocoons sent by Mr. Strachan, and un-

hesitatingly pronounce them to be formed by the larvæ of the *Tinea vastella*, Zell. = *gigantella*, Stn. = *lucidella*, Wkr., which is practically distributed over the whole of Africa and in various districts of India; the larvæ were believed to feed only on the horn of dead animals; it had been asserted to feed on that of living animals, but as the authority for this latter statement was based on the evidence of one eye-witness and by hearsay on the part of others, it was generally discredited, and by some held to be absurd.

"Dr. Fitzgibbon, as long ago as 1856, brought home from Gambia two pairs of horns, one pair belonging to *Kolus ellipsiprymnus*, the other to *Oreas canna*, which he had purchased from some natives in the market at Macarthy's Island, being struck with their appearance, as they were perforated by grubs enclosed in cases which projected abundantly from the surface of the horns, although they were taken from freshly killed animals, the blood not having thoroughly dried up on them when brought to market. The larvæ, evidently those of the *Tineidæ*, were found with the head outwards, indicating probably that they had arrived at their full growth, and had then turned round preparatory to final transformation." The point of this proves that the horns were infested while the animal was yet living which bore them. I have been unable to find any corroboration of this in working through the literature dealing with the subject.

I find that in 1867, at a meeting of the Ent. Soc. of London, "Mr. Stainton had to record a new habitat for the larva of a Tinea; Mr. Swanzy had shown him the larva case of a Tinea, which was taken from the horn of a Kooloo from Natal, and there would be little doubt that the larva must have been burrowing in the horn of a living animal." "Mr. Swanzy added that, since Mr. Stainton's visit, he had found a living larva in the horn."

"Prof. Zeller, in 1873, received from Herr Rogenhofer, of Vienna, one male and two females, with two larvæ and one pupa of a moth, the caterpillar of which *lives* in the horns of buffaloes at the Cape, the specimens agreeing exactly with *Scardia vastella*, Zell." In Prof. Zeller's opinion the larvæ fed on the dead horn, and he was in doubt as to the truth of its feeding on that of the living animal.

At a meeting of the Ent. Soc. of London, in 1878, Mr. Stainton exhibited specimens of "new horn-feeding Tinea (*Tinea orientalis*) reared from horns from Singapore, allied to the species from South Africa, of which the larvæ was *asserted* to feed in the horns of living buffaloes and antelopes, and which had been described by Zeller under the name of Vastella, and subsequently by himself under the name of Gigantella"; both names referring to the extraordinary size of the insect in the genus Tinea.

"Mr. Simmons, of Poplar, who found them in his greenhouse, was quite at a loss to account for their appearance, till Mr. Stainton suggested they were horn feeders, when he remembered a piece of horn placed on a shelf and forgotten, but which when examined showed evident traces of having been eaten, and from which pupa-skins had been obtained."

We have, therefore, the strong evidence of Dr. Fitzgibbon that the larvæ feed on the living horn, and as the fibre of the horn undergoes little or no change at death, there is no reason why the moth should not deposit its eggs while the living animal is at rest, nor why the larvæ should not penetrate the horn; notwithstanding, Lieut.-Colonel the Hon. Wenman Coke and Mr. Roland Trimen were confident that the larvæ did not feed on the living horn, giving as their reason, that having shot over many parts of Africa, had this been the case it could not have escaped their observation. Many naturalists and sportsmen have backed this opinion on the same grounds; it is, therefore, very gratifying that Mr. Strachan's letter places all doubts on one side, and our thanks are due to him for clearing up a matter which has been under judgment for nearly half a century.

W. H. MCCORQUODALE.

THE FUTURE OF VACCINATION.

IN certain quarters the impression seems to have gained ground that those who are antagonistic to systematic vaccination have, as the result of recent proceedings in Parliament, received fresh encouragement to persevere in their resistance. No doubt "anti-vaccinators" have claimed, and will continue to claim, that in the abolition of the compulsory clause they have justification for the course they have pursued. It is just possible that even some of those who believe in the good effects of vaccination as a protective measure against small-pox may be persuaded to take the same view, and it behoves all who have studied the question carefully to state the position as it presents itself to them.

In the first place, it must be evident that there is no room in the discussion of this subject for the introduction of political-party considerations. No doubt attempts will be made, and, unfortunately, have been made, by those who should know better, to drag this question through party mire. Neither party can free itself from this reproach, and the result is that the Vaccination Bill has not received the unbiassed consideration through which alone it could be rendered thoroughly practical, workable, and successful. The spirit of the Bill and the intention of its framers are excellent; its drafting, as is now seen, is exceedingly faulty.

It was one of the great merits of the report of the majority of the Royal Commissioners on Vaccination, that it was eminently judicial, both in tone and in substance. With the evidence before them they came to the conclusion that as to the prophylactic or protective value of vaccination against small-pox there could not be the slightest doubt. At the same time, they pointed out that under certain conditions, and in an infinitesimally small proportion of cases, there was a danger, although in most cases an easily preventible danger, of evil results accruing from the operation. In these circumstances, they did not close their eyes to the fact that there must always be a certain small section of people who would put the claims of individual feeling before the public welfare, not avowedly, of course, but rather on the very ground of the public welfare; and they indicated that in any future legislation it would be well, under certain stringent conditions, to allow this small minority to have its way, so far, at any rate, as its own children are concerned.

There can be little doubt that the Anti-Vaccination League is now kept alive by those who have from time to time been arraigned for not having their children vaccinated according to the law, and that, posing as martyrs, they have enlisted the sympathies of others who have no objection at all to vaccination as vaccination, but only as *compulsory* vaccination. The Commissioners at once saw the desirability of removing such a power from the hands of the anti-vaccinators, and suggested a most rational way of doing so. Make the man who wishes to become a martyr take some trouble, they say, and you quench some of his ardour; better still, do away with the possibility of his becoming a martyr, and you remove the sympathy and admiration on which so many of them have subsisted, whilst you allow the man who has genuine conscientious objections to vaccination to place his personal desires against the general welfare, but only at some considerable personal inconvenience. In this way the false would, in time, be weeded from the true, martyrs would disappear, and the anti-vaccination crusade would die of inanition. It must be acknowledged that, theoretically, compulsory vaccination affords the best possible protection yet known against small-pox epidemics, but in recent years the law has been administered in so lax a fashion, especially in certain towns and districts, that whole communities have been left unprotected, and the Gloucester and similar outbreaks have been the result. As this is the case, is it not better to devote attention to seeing that there is efficient and safe vaccination in those quarters in which science is not met and foiled by prejudice, and, where prejudice exists, to use every educational means to remove it or render it as harmless as possible? Medical men who know the ravages that small-pox wrought towards the end of the last and in the earlier part of the present century, and who have knowledge of the protective value of vaccination, can scarcely put themselves in

the position of the man who hears only the anti-vaccinator's story, and who is moved to the action he takes in regard to his own children by ignorant sentiment, and not by actual information. Practically *compulsory* vaccination has failed, because, as soon as the danger against which it was to protect was temporarily lost sight of, it was no longer enforced. Medical men were not oblivious of the danger of the recurrence of small-pox in unvaccinated communities, but they have not been able to convince their patients of the existence of the danger. Under these conditions, what can be done to counteract what has come to be a most dangerous agitation, the danger and importance of which, unless proper steps are taken, will go on increasing with every year that we are removed from the small-pox period, until we are again confronted with an unvaccinated population and a general epidemic of small-pox such as has not been experienced in the time of the oldest amongst us?

One step has already been taken: the man with conscientious objections (and it must be remembered that such men do exist, otherwise there would be no funds forthcoming for the payment of those by whom the agitation is principally kept alive) is allowed to enter his protest, and to prevent the child entrusted to his care from receiving protection against a disease which may disfigure and maim it for life.

The next step is to take every precaution (and to make punishable every lack of known precaution) that the lymph used shall be of the best, and the operation carried out under the most favourable conditions possible. In these days of surgical cleanliness, medical men do not require to be specially trained in respect to these two points.

Lord Lister, in his speech before the House of Lords, insisted strongly on the necessity of revaccination, on the ground that in the course of a few years the protective effect of vaccination gradually becomes weakened. This fact certainly came out very prominently before the Royal Commission, and, as may be gathered from the final report of the Commissioners, bulked largely in their minds when they made their recommendations for the guidance of future legislation. In the event of any serious attempt to continue the anti-vaccination movement, revaccination must form an important factor in the prevention of the spread of small-pox in epidemic form. When there is any outbreak of small-pox, those who have not already submitted themselves for revaccination, especially those who are in any way brought into contact with the disease, hasten to have themselves revaccinated, with, as is pointed out by the Report of the Commission, the very best results, as proved by the statistics relating to doctors, nurses, and others attending directly on small-pox patients. So, also, when there is the possibility of an outbreak of small-pox in epidemic form amongst those whom parents and guardians have left susceptible to the attack of this disease, revaccination should constitute an additional line of defence even for those already vaccinated in infancy. Under such conditions the vaccinated community may regard with equanimity the possibility of infection by small-pox, so far as they themselves are concerned, though they will still have to bear the brunt of pecuniary calls made for the stamping out of the disease in the unvaccinated or imperfectly vaccinated section of the population. The Vaccination Bill has been spoken of as "a great experiment." We do not hesitate to state that, under the above conditions, it will be one of the most convincing experiments ever performed, *especially if a record, to which reference may afterwards be made, be kept of every conscientious objector.* With vaccination and revaccination *efficiently carried out* in the bulk of the population, *and registration of the unvaccinated residuum*, this latter will no longer be a source of danger except to itself.

One thing more remains to be done to meet the anti-vaccinators with their own weapons. This matter, as Dr. Bond has pointed out, has been left too much in the hands of the medical man, who, as a rule, has little time and less money to devote to the carrying on of any propaganda in favour of vaccination. The bulk of the agitation against vaccination is carried on by laymen, many of whom display ingenuity and perseverance worthy of a better cause. These laymen, as for example in the Houses of Parliament, are convinced—often by mere hearsay—that they are thoroughly in the right, and the only way to deal with them successfully is to bring every scrap of evidence under their notice tellingly, and in authoritative form. This, for the present, can only be done by other laymen who have made a careful study of the question. In time bitter experience will convince some, but isolated cases, unless carefully made known, are of little value for the conviction of those not specially concerned. The Jenner Society has a great work before it in educating the public by making known everything that is to be said in favour of vaccination, and by recording the personal experience of those who have been attacked by small-pox. As an example of the effect of an outbreak of small-pox on the opinions of an anti-vaccinator, the following may be taken as being fairly typical. Mr. H——, a well-to-do and intelligent "Clerk of Works" on a large developing estate in Kent, was a strong anti-vaccinator. When the time came for him to have his first-born son vaccinated the law was evaded. A few years later, during an outbreak of small-pox, a tramp, suffering from the disease in an early stage, came to H.'s door to beg, and the child, sent to give him a piece of bread and butter, contracted small-pox, and, as the father and mother say, suffered most horribly. It was thought that the sight of both eyes would be lost, and the boy was terribly disfigured. So impressed was the father with the severity of the attack as compared with those in children who had been vaccinated, that he has had his other children vaccinated, and says that he would now gladly walk twenty miles and give ten shillings to help to persuade any father who has "conscientious objections" to vaccination to change his views on the subject. There are few such cases nowadays, but such a record is only the echo of what at one time was frequent enough, and unless the public takes up this matter in earnest, will be in the future. Doctors who understand what vaccination has already done will continue their efforts to protect the community, and will certainly see that this is done in their own families; but it rests with the wealthy and intelligent layman to do what he can to counteract the influence of anti-vaccination statements, spoken and printed, on the minds of the public.

Vaccination is a prophylactic measure, not a curative. Its beneficial effects can, therefore, not be seen except through statistics and in the modification of the type of the disease in those attacked. Moreover its effects can, even in these cases, now only be rarely seen, as owing to its action small-pox but seldom makes its appearance. Let it be remembered, however, that when anti-diphtherial serum was first introduced in this country there was a tremendous outcry against its use. "The brute force of facts" has silenced objectors for the present. With a death-rate reduced to two-thirds, or even one-half of what it was only three or four years ago, and with the type of disease completely altered (only, however, in those cases in which antitoxin is given), even the most obstinate objector is constrained to keep silence; but there can be little doubt that should diphtheria be almost eliminated from our midst, a prospect by no means beyond the reach of possibility, there would in time rise up a generation of doubters and objectors who would assail the anti-diphtherial serum treatment as stoutly and as blindly as do the anti-vaccination party of to-day and as did the anti-serum party of yesterday.

It may be said that sensible people do not listen to the

rubbish talked by those who take part in this agitation. Unfortunately this is not the case. As in every other relation of life, the old saying holds good, "Throw enough mud and some of it is sure to stick," and such as does stick can only be got rid of by thorough washing and efficient whitewashing. It is to this part of the work that we now wish to call the attention of all thoughtful men; and we can not help thinking that their work will be all the easier from the fact that the "compulsory" clause has been eliminated from a "Bill" that has already proved somewhat weak as an "Act," but which would have been still weaker as a legislative measure had not the amendment proposed in the House of Commons been ultimately carried in the House of Lords.

THE BRITISH ASSOCIATION.

THE meeting which has just been brought to a conclusion in Bristol may fairly be regarded as a highly successful one. The weather, though at first somewhat oppressive, has been on the whole eminently favourable for garden parties, conversazioni, and excursions. The destruction of the Colston Hall by fire raised difficulties at the last moment, but the emergency arrangements of the local committee amply met the requirements of the case. Although the seating accommodation of the People's Palace is far inferior to that of the Colston Hall, its acoustic properties are greatly superior. A brilliant audience met to hear Sir William Crookes's presidential address, and the members and associates attended in large numbers to listen to the discourses of Prof. Sollas and Mr. Jackson. Prof. Sollas's lecture on Funafuti was clear, lucid, and well illustrated, while Mr. Herbert Jackson's discourse on Phosphorescence, with his admirable experiments, is universally regarded as a brilliant success. The conversazione at Clifton College was well arranged and highly appreciated; the exhibits including a demonstration of the spectra of rare atmospheric elements by Prof. Ramsay and of wireless telegraphy, attracting large numbers, and the tastefully-lighted Close forming a pleasant promenade in the open air. The garden parties and the Saturday excursions have also gone off well. The Mayor of Bath took special trouble to make the excursion to Bath a pleasant one, and invited many members to visit the city and environs, the new excavations of the Roman Baths being especially visited and explained. Members who look forward to the meeting as a pleasant opportunity for social converse with their scientific *confrères* and with people of standing in the locality, have every reason to be well satisfied with the arrangements which have been made in Bristol. The old city has well maintained its tradition of hospitality. Sir William Crookes, speaking on Saturday at the banquet given by the Chamber of Commerce to distinguished visitors and guests, said that he had attended many meetings of the British Association, but could remember no occasion when the welcome accorded was more hospitable and enthusiastic, or the arrangements more carefully planned. In fact, it was agreed by all the members that the local arrangements have been a model of what such arrangements should be. The local hon. secretaries, Mr. Arthur Lee, J.P., and Dr. Bertram Rogers, have been indefatigable in their exertions, and have given nights as well as days to the work, hence everything has progressed with perfect smoothness.

The visit of four men-of-war has served to give an added interest to the meeting in its social aspect. This was a new feature, and was much appreciated both by the visitors and the local members. The ships' companies were not forgotten in the local arrangements, several entertainments being arranged for them. The officers of the Association provided for a lecture to be given to them upon a suitable topic, but it had to be cancelled, as the commander was unable, on account of his early departure, to grant leave to the 350 officers and men for whom arrangements had been made.

The very successful smoking symposium and concert given by the Scientific Societies of Bristol in the beautiful hall of the Merchant Venturers' Society's Technical College, assuredly gave no evidence of dulness. An excellent and humorous programme, capital speeches by the High Sheriff (Mr. Richardson Cross, the well-known oculist), Dr. Ryan (Professor of Engineering in University College, Bristol) and the president of the meeting, and the customary appurtenances of such a gathering, put all who were present in excellent humour.

We have alluded specially to the social aspects of the meeting. But they in truth form a not unimportant part of the work of the British Association. It is pleasant even to serious students of science to meet in the flesh those who have been hitherto met only on the printed page, and to find them after all eminently human; while words of kindly encouragement from older to younger workers are stimulating to renewed effort. Good work has been done in the Sections; but of this we hope to furnish an outline later on. The conference on terrestrial magnetism and atmospheric electricity, under the presidency of Prof. Rücker, was extremely well attended. Delegates from Germany, France, Holland, Italy, etc., were present, and most important conclusions were arrived at.

Everyone agrees that the local representatives of science have done all they could to stimulate interest in the neighbourhood of Bristol and the scientific work which is there being prosecuted, and it is, we hope, not invidious to make special mention of the work done by the Masters of Clifton College and the Professors at the Bristol University College to make the meeting successful. The local secretaries and their staff have spared no efforts to render the general arrangements efficient in themselves and intelligible to the members. The numbers in attendance approach 2500. The applications for tickets for the longer excursions on Thursday have been so numerous as to render their allotment a matter of difficulty; and the final four days' excursion to Devonshire will probably be taken by the limiting number of 100 visitors.

As to the work of the General Committee, the report of the Council of the Association was read by Prof. Schäfer at the meeting of the Committee on September 7, and among the matters of scientific interest referred to in it are the following:—

The Council have elected the following men of science who have attended meetings of the Association to be corresponding members:—Prof. C. Barus, Brown University; M. C. de Candolle, Geneva; Dr. G. W. Hill, West Nyack, N.Y.; Prof. Oskar Montelius, Stockholm; Prof. E. W. Morley, Cleveland, Ohio; Prof. C. Richet, Paris; Prof. W. B. Scott, Princeton, N.J. The Council were invited to nominate one or two members to give evidence before the Committee appointed by the Government to report on the desirability of establishing a National Physical Laboratory, and at their request Prof. G. Carey Foster, F.R.S., and Prof. W. E. Ayrton, F.R.S. gave evidence before this Committee. A report has been presented to Parliament, and the Council trust that the deliberations of the Committee will result in the establishment of a National Laboratory.

In regard to the resolutions referred to them for consideration and action, if desirable, the Council report as follows:—(1) That the Council appointed a committee to consider the desirability of approaching the Government with a view to the establishment in Britain of experimental agricultural stations similar in character to those which are producing such satisfactory results in Canada. The committee having reported that much is already being done in this direction by County Councils and

Agricultural Societies, advised that the co-operation of these bodies should first be invited. The committee was re-appointed for this purpose, and sent in a report, the principal recommendation of which was adopted by the Council, and is as follows:—"Your committee recommend that the Board of Agriculture be informed that, in the opinion of the British Association, there is an urgent need for the co-ordination of existing institutions for agricultural research, and that the Association hopes that steps may be taken towards this end, including the strengthening of the scientific work of the Board of Agriculture and the provision of the means for dealing adequately with scientific questions which may come before it." At the request of the Council this report was brought by the President to the notice of the President of the Board of Agriculture, from whom the following reply, dated July 26, was received:—"I have laid before the Board of Agriculture your letter of the 18th inst., and I am desired to express to the Council of the British Association for the Advancement of Science the thanks of the Board for the attention which the Council have been so good as to give to the important subject of agricultural research. The Board will not fail to bear in mind the views set out in the resolution communicated to them in the letter above referred to."

(2) That a committee was appointed to report to the Council whether, and, if so, in what form, it is desirable to bring before the Canadian Government the necessity for a hydrographic survey of Canada, and that the following formed the committee:—Prof. A. Johnson (chairman and secretary), Lord Kelvin, Prof. G. H. Darwin, Admiral Sir W. J. L. Wharton, Prof. Bovey, and Prof. Macgregor. The committee reported to the Council, and it was decided, in conformity with the recommendation contained in the report, that the following resolution should be sent to the Canadian Government:—"The Council of the British Association have learnt with regret that the Government of the Dominion of Canada is contemplating the discontinuance of their tidal survey of Canadian waters. Whilst the work already carried out is primarily connected with hydrography and navigation, they consider that science will incur a great loss if the work of the survey is discontinued. They would, therefore, urge on the Government the desirability of continuing the tidal survey as heretofore." The President transmitted the resolution to the Governor-General, who forwarded it to the Government of the Dominion of Canada for their favourable consideration. In reply, the Council were informed that "in view of the limited appropriation made by Parliament, it has been deemed advisable to defer the prosecution of the survey for the present and to confine the work to the maintenance and operations of the tidal gauges already established, and the preparation of tide tables."

(3) That a committee was appointed by the Council to consider the following resolution:—"That, in view of the facts (*a*) that a committee of astronomers appointed by the Royal Society of London, in consequence of a communication from the Royal Society of Canada, has recently considered the matter, and has arrived at the conclusion that no change can now be introduced in the *Nautical Almanac* for 1901, and (*b*) that few English astronomers are attending the Toronto meeting of the Association: the committees of sections A and E are not in a position to arrive at any definite conclusion with respect to the unification of time; but they think it desirable to call the attention of the Council to the subject, in which the interests of mariners are deeply involved, with the view of taking such action in the matter as may seem to them to be desirable." Several members of this committee had also served on the committee of the Royal Society, and after careful consideration of the whole question the committee saw no good reason for dissenting from the conclusion which had been recently adopted by the Royal Society and reported in the following terms:—"The committee report that as there is a diversity of opinion amongst astronomers and sailors as to the desirability of the adoption of civil reckoning for astronomical purposes, and as it is impossible to carry out such a change in the *Nautical Almanac* for the year 1901, they do not recommend that the Council of the British Association should at present take any steps in support of the suggested change of reckoning." The President has transmitted this report to the Royal Society of Canada.

In their report last year at Toronto, the Council informed the General Committee that the establishment of a Bureau for Ethnology was under the consideration of the trustees of the British Museum. In the course of their reply, dated December 15, 1897, the trustees state "that they are quite of opinion that such a bureau might be administered in connection with the Ethnographical Section of their collections, with advantage both to the objects in view of the Association and to the enlargement of the British Museum collections. They are, therefore, willing to accept in principle the proposal of the British Association, and they would be ready to take the necessary steps for carrying it into effect as soon as certain rearrangements affecting space, &c., which are now taking place within the museum, shall have been finished, as it is expected, in the course of the coming year."

In accordance with the regulations, the retiring members of the Council are: Prof. Edgeworth, Mr. Victor Horsley, Mr. G. J. Symons, Prof. W. Ramsay. The Council recommended the re-election of the other ordinary members of the Council, with the addition of the gentlemen whose names are distinguished by an asterisk in the following list:—Mr. C. Vernon Boys, F.R.S., Captain E. W. Creak, R.N., F.R.S., Mr. F. Darwin, F.R.S., the Hon. Sir C. W. Fremantle, K.C.B., *Dr. W. H. Gaskell, F.R.S., Prof. W. D. Halliburton, F.R.S., Prof. L. F. Vernon Harcourt, Prof. W. A. Herdman, F.R.S., *Dr. J. Scott Keltie, *Major P. A. MacMahon, F.R.S., Mr. J. E. Marr, F.R.S., Prof. R. Meldola, F.R.S., Prof. E. B. Poulton, F.R.S., Mr. W. H. Preece, C.B., F.R.S., *Mr. L. L. Price, Prof. J. Emerson Reynolds, F.R.S., Mr. W. N. Shaw, F.R.S., Mr. J. J. H. Teall, F.R.S., Mr. W. T. Thiselton-Dyer, C.M.G., F.R.S., Prof. S. P. Thompson, F.R.S., *Prof. J. M. Thomson, F.R.S., *Prof. W. A. Tilden, F.R.S., Prof. E. B. Tylor, F.R.S., Prof. W. C. Unwin, F.R.S., Sir W. H. White, K.C.B., F.R.S.

As to the financial position of the Association, the statement presented by Prof. Rücker showed that the receipts for the past year were 462*l.* 18*s.* 2*d.*, and that there was a balance of 170*l.* 3*s.* 8*d.* in the treasurer's hands.

At a meeting of the General Committee held on Monday, it was decided to accept the invitation of the municipal authorities at Bradford to meet there in the year 1900. Dr. Michael Foster was elected President for the meeting at Dover next year. The following Vice-Presidents were also elected:—The Archbishop of Canterbury, the Marquis of Salisbury, the Mayor of Dover, Lord Herschell, the General Commanding the South-Eastern District, Mr. Akers-Douglas, M.P., the Dean of Canterbury, Sir Norman Lockyer, and Prof. G. H. Darwin. Prof. Rücker was appointed a trustee, in succession to the late Lord Playfair. Profs. Schäfer and Roberts-Austen were re-elected general secretaries, and Mr. Griffith assistant general secretary. Prof. G. Carey Foster was elected to succeed Prof. Rücker as general treasurer.

At the meetings of the Committee of Recommendations, the following sums of money were voted for scientific purposes:—

Synopsis of grants of money appropriated to scientific purposes by the General Committee at the Bristol meeting, August 1898. *The names of the members entitled to call on the General Treasurer for the respective grants are prefixed.*

Mathematics.

	£
*Rayleigh, Lord—Electrical Standards (and £75 in hand)	225
*Judd, Prof. J. W.—Seismological Observations... ...	75
*Rücker, Prof. A. W.—"Science Abstracts"	100
Kelvin, Lord—Heat of Combination of Metals... ...	20
Fitzgerald, Prof. G. F.—Radiation in a Magnetic Field	50

Chemistry.

*Thorpe, Dr. T. E.—Action of Light upon Dyed Colours	10
Hartley, Prof. W. N.—Relation between Absorption Spectra and Constitution of Organic Substances ...	50
Ramsay, Prof. W.—Chemical and Bacterial Examination of Water and Sewage	10

Geology.

*Hull, Prof. E.—Erratic Blocks	15
*Geikie, Prof. J.—Photographs of Geological Interest ...	10
*Marr, Mr. J. E.—Life Zones in British Carboniferous Rocks	10
Dawkins, Prof. W. Boyd.—Remains of Irish Elk in the Isle of Man	15
*Dawson, Sir J. W.—Pleistocene Fauna and Flora in Canada	30
Hicks, Dr. H.—Records of Drift Section at Moel Tryfan	5
Hicks, Dr. H.—Ty Newydd Caves	40
Lloyd-Morgan, Prof. C.—Ossiferous Caves at Uphill ...	30

Zoology.

*Herdman, Prof. W. A.—Table at the Zoological Station, Naples	100
*Bourne, Mr. G. C.—Table at the Biological Laboratory, Plymouth	20
*Woodward, Dr. H.—Index Generum et Specierum Animalium...	100
*Newton, Prof. A.—Migration of Birds	15
Hoyle, Mr. W. E.—Apparatus for keeping Aquatic Organisms under definite Physical Conditions... ...	15
Lankester, Prof. E. R.—Plankton and Physical Conditions of the English Channel during 1899	100

Geography.

Keltie, Dr. J. Scott.—Exploration of Socotra	35

Economic Science and Statistics.

*Sidgwick, Prof. H.—State Monopolies in other Countries (Balance in hand)	
*Price, Mr. L. L.—Future Dealings in Raw Produce ...	5

Anthropology.

*Munro, Dr. R.—Lake Village at Glastonbury	50
*Brabrook, Mr. E. W.—Ethnographical Survey	25
*Evans, Mr. A. J.—Silchester Excavation	10
*Penhallow, Prof. D. P.—Ethnological Survey of Canada (and unexpended balance in hand)	35
Tylor, Prof. E. B.—New Edition of "Anthropological Notes and Queries"	40
Garson, Dr. J. G.—Age of Stone Circles	20

Physiology.

*Schäfer, Prof. E. A.—Physiological Effects of Peptone...	30
Waller, Dr. A.—Electrical Changes accompanying Discharge of Respiratory Centres	20
Gotch, Prof. F.—Influence of Drugs upon the Vascular Nervous System	10
Schäfer, Prof. E. A.—Histological Changes in Nerve Cells	20
Schäfer, Prof. E. A.—Micro-Chemistry of Cells ...	40

* Re-appointed.

	£
Schäfer, Prof. E. A.—Histology of Suprarenal Capsules	20
Gotch, Prof. F.—Comparative Histology of Cerebral Cortex	10

Botany.

*Farmer, Prof. J. B.—Fertilisation in Phæophyceæ ...	20
Darwin, Mr. F. Assimilation in Plants	20
*Stebbing, Rev. T. R. R.—Zoological and Botanical Publication...	5

Corresponding Societies.

*Meldola, Prof. R.—Preparation of Report...	25
	£1485

* Re-appointed.

INTERNATIONAL CONFERENCE ON TERRESTRIAL MAGNETISM AND ATMOSPHERIC ELECTRICITY.

OPENING ADDRESS BY PROF. A. W. RÜCKER, M.A., D.Sc., SEC. R.S., PRESIDENT OF THE CONFERENCE.

THE President of the Section of Mathematics and Physics has already expressed the pleasure with which British physicists welcome the distinguished band of visitors who have assembled to take part in the International Conference on Terrestrial Magnetism. None join in that welcome with more cordiality than those who are especially interested in the science with which the Conference will be occupied. To us it is a source both of gratification and pride that the International Committee, to whose action this meeting is due, should have allowed us to play the part of hosts to the eminent men from many lands who have responded to their call. Some, whom we would gladly have seen here, but who have been prevented from attending by various causes, have nevertheless shown the interest which they take in our proceedings by sending written communications. Thus our meeting is as fully representative as we could have hoped.

It may be interesting to those who are unaware of the fact if I remind the Conference that this is not the first occasion on which students of terrestrial magnetism have taken counsel together during a meeting of the British Association.

Fifty-four years ago the then President of the Association, the Very Rev. George Peacock, Dean of Ely, stated in his address that the period was drawing to an end for which a series of magnetic observatories had been established by international co-operation. "Six observatories," he stated (*Brit. Assoc. Rep.*, 1844, p. xliv.), "were established, under the zealous direction of M. Kupffer, in different parts of the vast empire of Russia, the only country, let me add, which has established a permanent physical observatory. The American Government instituted three others, at Boston, Philadelphia, and Washington; two were established by the East India Company, at Simla and Singapore; from every part of Europe, and even from Algiers, offers of co-operation were made." The observations thus provided for were to be carried out for three years only, but as nearly the whole of that time was spent in preparation, the period was doubled. When the term thus fixed drew to an end, the question arose as to whether it was desirable to extend it further, and M. Kupffer (Director-General of the Russian System of Magnetic and Meterological Observations) addressed a letter to Colonel (afterwards Sir Edward) Sabine, suggesting the propriety of summoning a Magnetic Congress to be held at the next meeting of the British Association.

In accordance with that suggestion the Congress was held during the meeting of the Association at Cambridge in 1845. The number of distinguished foreigners who attended in person was considerable in spite of the difficulties of travel fifty years ago. Amongst those who were present was M. Kupffer, Dr. Erman, of Berlin, the celebrated circumnavigator and meteorologist, Baron von Senftenberg, the founder of the Astronomical and Meterological Observatory of Senftenberg in Bohemia; M. Kreil, the director of the Imperial Observatory at Prague; Dr. von Boguslawski, the director of the Royal Prussian Observatory at Breslau; Herr Dove, professor of physics in the University of Berlin; and Baron von Waltershausen, a gentleman who had taken part in the magnetic observations of Gauss and Weber at Göttingen, and had executed a magnetic survey of portions of Italy and Sicily. In addition

to these a number of well-known British men of science were invited to be present, amongst whom I need only mention the Marquis of Northampton (President of the Royal Society), Sabine, Sir John Herschel, Lloyd, Airy, Brown, and Sir James Ross, then recently returned from his celebrated expedition to the Antarctic seas. Letters were also received from Wilhelm Weber, Gauss, Loomis, Lamont, Quetelet, Von Humboldt, and others.

The principal question which this conference had to decide was whether "the combined system of British and foreign co-operation for the investigation of magnetic and meteorological phenomena, which [had then] been five years in progress, must be broken up" (*Brit. Assoc. Rep.*, 1845, p. 69). I will not trouble you with a recapitulation of the recommendations of the Congress, some of which have been carried out, while others have not yet been realised; but one resolution will, I am sure, so exactly express your own sentiments that I venture to quote it, viz.: "That the cordial co-operation which has hitherto prevailed between the British and foreign magnetic and meteorological observatories having produced the most important results, and being considered by us as absolutely essential to the success of the great system of combined observation which has been undertaken, it is earnestly recommended that the same spirit of co-operation should continue to prevail." Whatever changes half a century may have wrought in the problems which press upon magneticians, and in the difficulties which confront them, there can be no doubt that they are still of the same spirit as that in which this resolution was framed.

It is true that we sometimes meet with the objection that international conferences of all kinds are now too numerous, and that their decisions from their very number and complexity cease to attract attention or to command respect. Admitting that this objection is not without weight, it may be answered by two remarks. The closer union between scientific workers in different countries which these meetings encourage, the strengthening of the ties of intellectual sympathy by those of personal friendship are in themselves good. It is surely a hopeful omen that science, as she reaches her maturity, forgets or ignores the political and geographical boundaries which sometimes seemed so important in her youth, and that workers for the common good are more and more learning that it is good to work in common.

But there are special and cogent reasons why the science of Terrestrial Magnetism should be cosmopolitan. The advance of some sciences is most easily achieved by the methods of guerilla warfare. In a hundred different laboratories widely separated workers plan independent attacks on nature. In different universities and colleges little groups are devising stratagems and arranging ambuscades in the hope of wresting from our great opponent some of the treasures which she yields only to the violent who take them by force. But for those who would unravel the causes of the mysterious movements of the compass needle concerted action is essential. They cannot, indeed, dispense with individual initiative, or with the leadership of genius, but I think that all would agree that there is urgent need for more perfect organisation, for an authority which can decide not only what to do, but what to leave undone.

The advance of the science of Terrestrial Magnetism must depend upon the establishment, the maintenance, and the utilisation of the records of observatories. The bulk of the material to be dealt with must in any case be vast, and every needless addition to it, every obstacle in the way of its being readily comprehended and easily used, is a drawback which proper organisation should prevent.

Thus it is wasteful to devote to the multiplication of observatories, in regions of which we know much, energy and funds which would be invaluable if applied to districts of which we know little or nothing. I take some credit to myself in that within the last few months I have assisted in checking well-intended but mistaken proposals to add to the number of the magnetic observatories which we already possess in this country.

Again, it is desirable that the records of the observations should be so published as to be ready for application to the problems the solution of which they are intended to subserve, and that the individual worker should not be harassed by petty differences in the methods of presentment, which often entail on him labour too enormous to be faced. On this point something has already been done by international co-operation, and we may hope that this meeting will do much to complete the task.

Lastly, there are many investigations which are now undertaken independently at irregular intervals which would be far more useful if planned in common. Thus there has of late been a great outburst of energy in Europe devoted to magnetic surveys more detailed than have ever before been accomplished. Is it too much to hope that when the time comes for these to be repeated they may be carried out simultaneously, and reduced by the same methods, so that we may have a magnetic map of Europe in which no uncertainty as to the accuracy of details is introduced by the necessity for correcting for the secular change over long intervals of time?

Taking it, then, for granted that international co-operation is desirable for purposes such as these, I come next to the question of the nature of the machinery by which it shall be secured. And here I may at once state that the arrangements under which we are meeting to-day are in some respects abnormal, and that plans for the future will have to be formally or informally considered before we part. Meanwhile, it is desirable that I should state precisely the circumstances which have brought us together.

The last meeting of the International Meteorological Conference was held in Paris in September 1896. It was attended by several men of science specially interested in Terrestrial Magnetism, and, perhaps on this account, a new departure was taken by the International Committee, in the appointment of a "Permanent Committee for Magnetism and Atmospheric Electricity," to which certain specific questions were referred. Eight gentlemen were nominated as members of this Committee, with power to add to their number. We in turn co-opted eight other magneticians, taking care that as far as possible all countries in which Terrestrial Magnetism is specially studied should be represented. About the same time, and, as I believe, in ignorance of the establishment of this Committee, a suggestion for the assembling of an International Conference on Terrestrial Magnetism was made in the journal of that name by Prof. Arthur Schuster. It appeared to me and to Prof. Schuster himself that it would be a great pity if this suggestion resulted in the establishment of a rival organisation, and I at once submitted to the Committee the question whether, in their opinion, it was desirable that we ourselves should take the responsibility of summoning an international meeting, with the view of obtaining a wide discussion of the points submitted to us by the Meteorological Conference. This suggestion was approved, and as the British Association was willing to allow us to organise the Conference as a branch of Section A (Mathematics and Physics), to undertake the expense of sending out the necessary notices, to print our papers in its Report, and to extend to foreign members of the Conference all the privileges of foreign members of the Association, it was also determined that so hospitable an invitation should be accepted with the gratitude it deserved. But although the main result has been achieved, and a representative gathering of magneticians has assembled in Bristol, it cannot be denied that our relations to the various bodies with which we are connected are somewhat complicated, and that our constitution is devoid both of simplicity and symmetry. I take it that these facts are signs of health and vigour rather than symptoms of decay. Terrestrial Magnetism has been attracting far more attention of late years than in the not very distant past. The necessity for meeting, for common action, for common publication has been forced upon us. We have cared more for meeting than for the terms on which we were to meet, more for acting together than for drawing up an elaborate deed of partnership, more for the promotion of science than for a flawless paper constitution. Thus, and in my opinion most wisely, we have sought to attain our ends, not by starting a brand new International Association, but by making use of machinery which is already in existence, which has stood the test of time, and is, as I believe, capable of being put to new uses in meeting our wants and supplying our deficiencies.

I confess, however, that in this arrangement we have been compelled to pay scant attention to the simplicity and even to the logical consistency of our schemes. We are an International Conference on special subjects—Terrestrial Magnetism and Atmospheric Electricity—summoned by a Committee owing its authority and bound to report to another International Conference of wider scope, which regards our sciences as branches of Meteorology.

On the other hand, this Committee is for the moment a part of the Committee of the Section of Mathematics and Physics of the British Association, though it retains its right of separate

meeting, more especially for the discussion of its report to the International Meteorological Conference. It is evident that here there is plenty of opportunity for collision between rival authorities, for confusion between conflicting jurisdictions; but to all questions as to the precise limits of authority and jurisdiction it is sufficient to reply in the most general terms. The whole of the arrangements are temporary, to meet an immediate pressing need. The work of the Conference will be conducted like that of a Department of the British Association. The members of the International Committee will act as the Committee of the Department, but some of their work will be done on the General Committee of Section A, of which other magneticians will also be members. Should it be necessary, they will hold some separate meetings, and some such meetings will certainly be necessary to discuss their report to the International Meteorological Conference. These general regulations will probably suffice for all practical purposes. If cases occur which they do not cover, we must deal with them as they arise.

With regard to the future, I do not propose to lay before you any detailed scheme, but in discussing the matter among ourselves, the following principles should, in my opinion, be adhered to. The International Meteorological Conference has held a number of successful meetings. I believe that I am correct in saying that the right to attend that Conference was at first confined to those who were officially connected with Meteorological and Magnetic observatories, but that of late invitations have been more widely distributed. If the authorities of that Conference see their way to inviting in future most or all of those who are known to be specially interested in Terrestrial Magnetism, I do not see why the Magnetic Conference, which would then be constituted once in five years, should not meet all our requirements. If, however, additional meetings are necessary, I would urge that they should be held in turn in different countries, and, if possible, in connection with existing societies which play elsewhere the part taken by the British Association in this country.

That a permanent committee should be established is essential, and the mode of appointing this body must no doubt be considered, but I hope that in the course of the next few days the committee may be able to discuss the whole question, and that when the next meeting of the Meteorological Conference takes place we may be able to lay before the Committee suggestions which may lead to the foundation of an International Magnetic Association on a stable and permanent basis.

Another matter of great importance is the maintenance of an international journal devoted to Terrestrial Magnetism. This we now possess, thanks to the energy of Dr. Bauer, and I feel sure that all present will agree that such a means of intercommunication is invaluable. I believe, however, that the enterprise is threatened with financial dangers, and I desire to take this opportunity of urging all those who are interested in its success to do what they can to support it by increasing the circulation. There is every reason for making more use of a common journal. The records of the observatories are necessarily so bulky, that any one who desires to obtain the facts as to the magnetic state of the earth at any given time must collect or consult a large library of quarto volumes, in some of which the magnetic facts are mingled with data interesting chiefly to the meteorologist or astronomer. It is no doubt essential that an account of all the work done at each observatory should be published in a collected form, and that full details of the magnetic observations should be given; but for many, nay, for most, purposes, those who use the records will require only final results; the means of the various elements for the year, for each month, or for any other period which may hereafter be adopted, and the mean diurnal variation, are in general wanted, rather than the hourly values. If these means could be published together, once a year, an enormous boon would be conferred upon magneticians. For special purposes the theorist will have to test his views by reference to the results published in their fullest detail; but it would be no slight gain if the more salient facts could be compared by being placed side by side in the same journal. One advantage such a system would unquestionably possess. It would impress upon the authorities of the observatories the necessity for adhering to a common form of publication.

Some small beginnings have already been made. The Kew Observatory Committee now publish in the *Proceedings* of the Royal Society the annual means of the elements recorded by all the observatories which send their publications to Kew. By comparing two of these tables, the secular change can at once be determined. But the system is capable of extension, not merely to the normal values of the elements, but to disturbances. By common agreement, Greenwich and Parc St. Maur publish in each year the records of the same magnetic storms. If this agreement could be extended, and if the facts thus selected were brought into juxtaposition, we might hope for a fuller and more instructive analysis than is at present usual.

Turning from questions of organisation, the primary business of our conference will be to discuss four questions submitted to our Committee by the International Meteorological Conference.

The first two of these refer to the methods for calculating and publishing the monthly means of the magnetic elements which should, in our opinion, be adopted. I will not anticipate the discussion which will take place on these points, except to say that it will be necessary to bear in mind not only what is desirable, but also what is practicable in view of the resources at the disposal of the directors of the various magnetic observatories.

Another question deals with the relative merits of long and short magnets, and on this point we shall have the advantage of hearing a report on the subject by M. Mascart.

Lastly, there is a very important proposal for the establishment of temporary magnetic observatories at certain specified places. General Rykatcheff and Prof. von Bezold present an excellent report on this subject, and I will only remind you that whereas the accuracy of the mathematical expression of the magnetic state of the earth's surface depends entirely on the number and position of the spots at which the magnetic elements are accurately known, the establishment of temporary observatories will be a costly undertaking, for the carrying out of which all the resources at the disposal of international science will have to be employed.

Another point of considerable practical importance will also be brought before us. The rapid extension of electrical railways and tramways is a serious menace to magnetic observatories. From all parts of the world we hear of observatories ruined or threatened by the invasion of the electrical engineer. Toronto and Washington have already succumbed; Potsdam, Parc St. Maur, Greenwich, and Kew are besieged, and the issue largely depends upon whether these great national observatories can or cannot make good their defence.

It seems to be a law of nature, ruling alike the human race and the humblest microbe, that the products of an organism are fatal to itself. The pessimist might infer that we are in presence of another instance of the universality of the application of this law, and that pure science is threatened by the very success of its practical applications. The smoke of our cities blots the stars from the vision of the astronomer, who, like the anchorites of old, flies from the world to mountains and desert places. It is only in the small hours of the morning when

> "Save pale recluse, for knowledge seeking,
> All mortal things to sleep are given,"

that the physicist can escape from the tremors of the traffic of a great town.

Civilisation as it spreads by aid of the means that science has placed at its disposal is destroying records, and obliterating boundaries by the study of which the anthropologist and the biologist might have read far back into the history of our race. And now in turn the science of Terrestrial Magnetism, which, on the one hand, is forging another link to connect the sun and earth, and, on the other, is penetrating within the surface of the globe to depths beyond the ken of the geologist, is threatened by the artificial earth currents of the electric railway.

That the crisis is serious there can be no doubt, but I will only anticipate the fuller discussion which will take place by stating that magneticians, in common with the rest of the world, recognise the great benefit which electric traction confers upon the community at large. We are not so foolish as to desire to embark on a crusade against a great industrial improvement of which science may well be proud; on the other hand, we must hold fast to the position that provision for the conveniences which are immediately appreciated by the public should be made with as little damage as possible to those studies which are not less for the ultimate benefit of the race.

Had science, when the use of coal was introduced, been sufficiently advanced to devise means for smokeless combustion, an evil, which now in more senses than one darkens the lives of the inhabitants of our great towns, might have been prevented from attaining its present gigantic proportions.

We are now at the beginning of another industrial epoch, which may indeed, if power is transmitted from a distance on a large scale, brighten our skies, but which threatens to saturate the earth beneath us with electric currents. That these may interfere with the general comfort is evident from the injury which has been done to underground pipes at Washington and elsewhere. The construction of a powerful electric railway in the immediate neighbourhood of the laboratories of a college would interfere with its efficiency, and make it impossible to perform experiments of certain types. In such a case, however, something could be done by arranging the experiments to suit the conditions under which they would have to be performed. But in the case of a magnetic observatory no such protective measures are possible. The very object of the observatory is to measure the earth's field, and if that field is artificially altered, no modification of the methods of measurement, however ingenious, can overcome this fundamental defect. I am glad to take this opportunity of acknowledging that both the danger to pure science and the necessity for obviating it have been acknowledged by those who are chiefly interested in the technical applications of science; and in particular that one of the principal technical journals, the *Electrician*, has supported the view that industry can and ought to respect the necessities of research.

If, however, there be any who are inclined to ask whether the careful study of Terrestrial Magnetism has led or is leading to any definite results, or whether we are not merely adding to the lumber of the world by piling up observations from which no deductions are drawn, we may answer that, though the fundamental secret of Terrestrial Magnetism is still undiscovered, the science is progressing. In the presence of several of the most active workers I will not enter into a detailed discussion of the tasks to which they are devoting themselves; I will only ask that the doubter should compare a good summary of the state of the science of Terrestrial Magnetism written fifteen or twenty years ago, such as that contained in the article by Balfour Stewart in the "Encyclopædia Britannica," with what would be written on the same subject to-day. Additions would have to be made to the descriptions of the instruments employed, to the discussion of the theory of the diurnal and secular change, while such questions as the reality of earth-air currents, and the tracing of loci of local disturbance have only been dealt with effectively in very recent times. When, too, we compare the older models of the magnetic state of the earth with that devised by Mr. Henry Wilde we cannot but admit not only that a great advance has been made in forming a simple diagram of the magnetic state of the earth, but that it is possible that the model contains a very pregnant hint as to the physical construction of the earth as a magnetic body.

The fact that Mr. Wilde has imitated the declination and dip with remarkable accuracy all over the surface of the earth by means of a simple arrangement of electrical currents, and by coating the oceans with thin sheet iron, has not attracted the attention it deserves. Whether the physical cause thus suggested be due to the greater depth to which the underground isothermals penetrate below oceans, the bottoms of which are always cold, or whether the geological nature of the rocks is different below the great depressions and elevations of the earth's surface, respectively may be open to question, but I am persuaded that the matter should be more fully investigated.

In conclusion, let me once more revert to the points on which I dwelt at the beginning of this brief address. We meet with the confidence of men who know that their science is progressing, but with the mingled hopes and fears of those who still have to deal with the great unsolved problem of the causes of Terrestrial Magnetism and of its manifold fluctuations. This solution will be most easily attained if we are not merely content to collect facts, but if we so arrange that they shall be easily dealt with. To observe is our first duty, to organise our second, and if these be fulfilled we may hope that a theory of terrestrial magnetism will in the future crown the efforts not merely of him on whom the first glimpse of the truth may flash, but of the international co-operation which has, by way of preparation, made "the crooked straight and the rough places plain."

SECTION C.

GEOLOGY.

Opening Address by W. H. Hudleston, M.A., F.R.S., President of the Section.

Introductory.—About this time last year British geologists were scattered over no inconsiderable portion of the northern hemisphere, partly in consequence of the International Geological Congress at St. Petersburg, and partly owing to the meeting of the British Association at Toronto. From the shores of the Pacific at Vancouver, on the one hand, to the highlands of Armenia on the other, there were parties engaged in the investigation of some of the grandest physical features of the earth's surface.

The geologists in Canada were especially favoured in the matter of excursions. Everything on the American continent is so big that a considerable amount of locomotion is required to enable visitors to realise the more prominent facts. If there is no great variety of formation in Canada, yet the Alpha and Omega of the geological scale are there most fully represented, from the great Laurentian complex at the base to the amazing evidences of glacial action, in a country where it is possible to travel for a whole day without once quitting a glaciated surface. But Russia presented equal attractions, and in Finland almost identical conditions were observed, viz. glacial deposits on Archæan rocks. The great central plain of Russia, too, with its ample Mesozoic deposits often abounding in fossils, offered attractions which to some may have been stronger than the mineral riches of the Urals, or the striking scenery of the Caucasus.

It seems almost incredible, even in this age of extraordinary locomotion, that scenes so wide apart were visited by British geologists last autumn. This year we are more domestic in our arrangements, and Section C finds its tent pitched once more on the classic banks of the Bristol Avon, and in that part of England which has no small claim to be regarded as the cradle of English geology. But we may go a step further. For if the strata observed by William Smith during the six years' cutting of the Somersetshire coal-canal imprinted their lessons on his receptive mind, it is also equally true that Devonshire, Cornwall, and West Somerset first attracted the attention of the "Ordnance Geological Survey." And thus it comes to pass that the region which lies between the Bristol Channel and the English Channel claims the respect of geologists in all parts of the world, not only as the birthplace of stratigraphical palæontology, but also as the original home of systematic geological survey.

The city of Bristol lies on the confines of this region, where it shades off north-westwards into the Palæozoics of Wales, and north-eastwards into the Mesozoics of the Midland counties. There are probably few districts which display an equal amount of variety within a limited circumference. The development of the various formations was excellently portrayed by Dr. Wright, when he occupied this chair twenty-three years ago—so well, indeed, that his address might serve as text-book on the geology of the district. In the following year (1876) there appeared the Survey Memoir on the Geology of East Somerset and the Bristol Coal-fields, by Mr. H. B. Woodward, who has since contributed important memoirs on the Jurassic rocks of Britain, which are so largely developed in Somerset and the adjacent counties. Since that date many papers also have appeared in various journals, and some of these, as might be expected, give new and perhaps more accurate interpretations of phenomena previously described. In addition to this, portions of the south-west of England have been geologically re-surveyed, and in some cases new maps have been published.

I would call especial attention to the Survey map on the scale of four miles to the inch, known as the "Index-map," which has recently been issued. Sheet 11 includes this particular district; but if a portion of sheet 2 is tacked on to its southern border, we obtain a block of country about 120 miles square, which has not its equal for variety of geological formation in any part of the world within the same space. If Europe is to be regarded as presenting a geological epitome of our globe, and if Great Britain is an epitome of Europe, then, without doubt, this particular block of the south-west, which has Bath for its more exact centre, with a radius (say) of fifty miles, may be said to contain almost everything to be found on the geological scale, except the very oldest and the

very youngest rocks; while east of the Severn and south of the Bristol Channel true Boulder clay is rare or absent.

It may be convenient to consider a few points which have arisen of late years in connection with the geology of portions of the district now under consideration.

Palæozoic.—If we omit the Silurian inlier at Tortworth, the geological history of the country, more immediately round Bristol, may be said to commence with the Old Red Sandstone, whose relations with the Devonian towards the south-west, have always presented some difficulty. And this difficulty is accentuated by doubts as to the true Devonian sequence in West Somerset and North Devon. Ever since the days of Jukes that region has been fruitful in what I must continue to regard as heresy until the objectors have really established the points for which they are contending. The uncertainty is to be regretted, since it is through these beds of West Somerset that the system is to be made to fit in with the several members of the Old Red Sandstone.

There is a mystery underlying the great alluvial flats of Bridgewater which affects more than one formation; so much so, that one cannot avoid asking why there should be Old Red Sandstone in the Mendips and Devonian in the Quantocks. The line which separates the Old Red Sandstone of South Wales and the Mendips from the West Somerset type of Devonian lies here concealed. I have already suggested (*Trans. Devonsh. Assoc.*, vol. xxi., 1889, p. 45) that, if we regard the Old Red Sandstone of South Wales as an inshore deposit over an area which was deluged with fresh water off the land, we can believe that further out to sea, in a south-westerly direction, the conditions were favourable for the development of a moderate amount of marine mollusca. This view not only does away with the necessity for a barrier, but it also, in a general sense, suggests a kind of gradation between the Old Red and Devonian deposits. Mr. Ussher, whose practical acquaintance with this region dates from a long period, stated a few years ago that, "As far as Great Britain is concerned, the true connections of the Old Red Sandstone beds with their marine Devonian equivalents have yet to be carefully worked out on the ground."[1] I am not aware that further progress has been made in this direction.

The Carboniferous Limestone of the Bristol area has attracted the attention of so many distinguished geologists that its palæontology and general features are tolerably familiar. Of late years we owe some interesting petrographic details to Mr. Wethered. The varying thickness of the Carboniferous Limestone and also of the Millstone Grit in this part of England is noteworthy. If we follow the Carboniferous Limestone in a south-westerly direction, across the mysterious Bridgewater flats, a change is already noted in the case of the Cannington Park limestone, which was the subject of so much discussion in former years. Referring to this, Mr. Handel Cossham (*Proc. Cottes. Club*, vol. viii, 1881–2, p. 20 *et seq.*) was so sanguine as to believe that its identification with the Carboniferous Limestone would have the effect of extending the Bristol coal-field thirteen miles south of the Mendips. However this may be, all further traces of Carboniferous rocks fail at this point. After crossing the vale of Taunton, when next we meet with them in the Bampton district, the Culm-measure type, with its peculiar basal limestones, is already in full force.

In the new "Index-map" the Culm-measures are placed at the base of the Carboniferous series—below the Carboniferous Limestone. It is no part of my purpose to attempt any precise correlation, but I would point out the somewhat singular circumstance that the change to Culm rock occurs only a few miles to the south-west of the line where, in the previous system, we have already seen that the Old Red Sandstone changes into the Devonian. This curious coincidence may be wholly accidental, or it may be the result of some physical feature now concealed by overlying formations.

Since 1895 a new light has been thrown on the Lower Culm-measures by the discovery of a well-marked horizon of Radiolarian rocks. One result of the important paper of Messrs. Hinde and Fox has been to alter materially our views as to the physical conditions accompanying the deposition of a portion of the Culm-measures. The palæontology leads the authors to conclude (*Quart. Journ. Geol. Soc.* vol. li., 1895, p. 662) that "the Lower *Posidonomya*- and Waddon Barton Beds are the representatives and equivalents of the Carboniferous Limestone in other portions of the British Isles; not, however, in the at present generally understood sense that they are a shallow-water facies of the presumed deeper-water Carboniferous Limestones, but altogether the reverse, that they are the deep-water representatives of the shallower-formed calcareous deposits to the north of them. . . . The picture that we [Messrs. Hinde and Fox] can now draw of this period is that while the massive deposits of the Carboniferous Limestone—formed of the skeletons of calcareous organisms—were in the process of growth in the seas to the north [*i.e.* in the Mendip area and elsewhere] there existed to the south-west a deeper ocean in which silicious organisms predominated and formed these silicious Radiolarian rocks."

This is probably a correct view of the case, but one cannot help wondering that the ocean currents and other causes did not effect a greater amount of commingling of the elements than seems to have taken place. As a practical result, this discovery of a Radiolarian horizon in the Culm-measures has been of service in enabling surveyors to discriminate between Devonian and Carboniferous in the very obscure area on the other side of Dartmoor. This, I ventured to predict, would be the case when the paper was read before the Geological Society.

The principal features of the Bristol coal-field are too well known to call for many remarks. It would seem that the Pennant rock was formerly regarded as Millstone Grit, until Mr. Handel Cossham, in 1864, pointed out the mistake. Mr. Wethered gave a good description of the Pennant in his paper on the Fossil Flora of the Bristol coal-field (*Proc. Cottes. Club*, vol. vii, 1878, p. 73). It might seem almost unnecessary to refer to the existence of such a well-known formation as the Pennant, but for the fact that in a recent scheme of the Carboniferous sequence in Somersetshire the Pennant rock was wholly omitted.

The interest now shifts from the almost continuous deposition of the later Palæozoics, in one great geosynclinal depression, to an entirely different class of phenomena. Nowhere, perhaps, are the effects of the post-Carboniferous interval better exhibited than in those parts of the south-west of England where Tertiary denudation has removed the Mesozoic deposits. Here we perceive some of the effects of the great foliations which terminated the Palæozoic epoch in this part of the world. The immense amount of marine denudation which characterises this stage is particularly obvious in the anticlinals, which were the first to suffer, as they came under the planing action of the sea.

Attention may be drawn to a peculiarity which has no doubt been observed by many persons who have studied a map of the Bristol and Somerset coal-field. It will be seen that the strike of the Coal-measures is widely different on either side of a line which may be drawn through Mangotsfield to a point north of Bristol. The beds north of this line have for the most part a meridional strike, nearly parallel with the present Cotteswold escarpment; south of this line the strike is mainly east and west, though much curved in the neighbourhood of Radstock and the flanks of the Mendips. Of course this is only part of an extensive change in the direction of flexure, much of which is still hidden under Mesozoic rocks. Mr. Ussher, in the paper previously quoted, tells us that the line of change of strike may be traced in the general mass of the Palæozoic rocks, from near Brecon in South Wales to the neighbourhood of Frome. This means that within the Bristol district two distinct systems of flexure must have impinged on each other in post-Carboniferous times. Have we not here, then, another instance of extraordinary change within the limits of our area? This time it is not a mere change in the nature of a deposit, like that of the Old Red Sandstone into the Devonian, or of the Carboniferous Limestone into the Culm-rock, but a change in the direction of the elevatory forces, which had made its mark on the structure of our island even at that early date.

At this point I ought to quit the Palæozoics; but there is just one subject of interest which claims a momentary attention, viz. the probability of finding workable coal east of the proved Somersetshire field. I avoid the question of coal south of the Mendips as being too speculative, on account of the chances of deterioration of the coal-measures in that direction. But in view of the forthcoming meeting of the British Association at Dover, the question of finding coal to the eastward of Bath becomes a specially interesting subject for discussion. It is also a matter of some consequence whether the hidden basin or basins belong to the meridional or to the east and west system of flexures.

[1] Prospects of obtaining coal by boring south of the Mendips, *Proc. Som. Nat. Soc.*, vol. xxxvi. (1891) pt. 2, p. 104.

The latter is most likely to be the case.[1] The vale of Pewsey has been mentioned as a suitable locality for boring along the line of the recognised axis.

But prospectors should bear in mind the warning of Ramsay, that the basins containing coal are but few in comparison with the number of basins throughout the palæozoic rocks. No doubt the line indicated is more favourably situated for coal-exploration than the eastern counties; where, for instance, the Coal Boring and Development Company has lately gone into liquidation. The unsuitability of East Anglia as a field for coal-prospecting was insisted on in my second anniversary address to the Geological Society (*Quart. Journ. Geol. Soc.* vol. i., 1894, p. 70), and the results seem to have been very much what might have been expected. If coal is to be found beneath the Secondary rocks, the line of search should be carried through the counties of Kent, Surrey, Berkshire, and Wiltshire, though the three latter counties have hitherto been content to leave their underground riches unexplored. The Kent Coal Exploration Company is doing some good work with a reasonable chance of success; though if they wish to find coal sufficiently near the surface they had better adhere as much as possible to the line of the North Downs, since operations on the Sussex side are only too likely to be within the influence of the Kimmeridgian gulf, which was proved to exist at Battle (Netherfield). Mr. Etheridge, I hope, will have something to tell us as to the progress of the Kent Collieries Corporation, who now carry on the work at Dover.

Secondary or Mesozoic Rocks.—Commencing a totally different subject, I must now direct attention to the "red beds" and associated breccias so characteristic of eastern Devonshire. These rest in complete discordance on the flanks of the palæozoic highlands, and must be regarded as forming the base of the Secondary rocks of that district.

By the Geological Survey this series has hitherto been mapped as Trias, but in the new "Index-map" they are coloured as Permian. There is no Palæontological evidence which would connect them with the fossiliferous Permians, usually regarded as of Palæozoic age, but it has been evident for some time past that opinion was inclining to revert to the views of Murchison and the older geologists, more especially as to the position of the breccias so largely charged with volcanic rocks. The subject was dealt with by Sir A. Geikie in his address to the Geological Society, where he speaks of some of these rocks as presenting the closest resemblance to those of the Permian basins of Ayrshire and Nithsdale (*Quart. Journ. Geol. Soc.*, vol. xlviii., 1892, p. 161).

One difficulty which presented itself to the Devonshire geologists in accepting the Permian age of the "red beds" was, that the whole of the lower Secondary rocks appeared as an indivisible sequence, proved by its fossils to be of Keuper age at one end, and therefore inferentially of Keuper age at the other. Dr. Irving, however, considered that at the base of the Budleigh Salterton pebble-bed there is a physical break of as much significance as that between the Permian and Trias of the Midlands. In the marls which underlie this pebble-bed he recognised a strong resemblance to the Permian marls of Warwickshire and Nottinghamshire; and Prof. Hull, who had been studying the sections east of Exmouth about the same time, ultimately acceded to this view.[2] Its acceptance by the Survey thus throws all the Exmouth beds into the Permian; and that formation, according to the new reading, has an outcrop of some thirty-five miles from the shores of the English Channel to within three miles of Bridgewater Bay. The fertility of these red clays, loams, and marls has long been recognised by agriculturists, and it is not improbable that the abundance of contemporaneous volcanic material may in some measure have contributed to this result.

In conformity with the new mapping, the Budleigh Salterton pebble-bed and its equivalents to the northwards are accepted as of Bunter age, and thus constitute the base of the Trias in the south-west. Like most pebble-beds, they are irregularly developed between the Permians and a strip of reddish sandstone (coloured as Keuper), which runs up from the mouth of the Otter to within a short distance of Bridgewater Bay. The materials of the pebble-beds are not of local origin, like so much of the breccia at the base of the Permian. The general resemblance, both as regards scenery and composition, to the Bunter conglomerate of Cannock Chase has been pointed out by Prof. Bonney, who seems prepared to endorse the recognition of the Budleigh Salterton pebble-bed as a Bunter conglomerate. He was not impressed by any marked unconformity with the underlying series. To some extent we may accept this view, since whatever may be the age of the Devonshire breccias and "red beds," they, in common with the Trias, must have been deposited under fairly similar physical conditions in a sort of Permo-Triassic lake basin.

The bulk of the Trias, including the Dolomitic Conglomerate of the Bristol district, is still regarded as of Keuper age, though it is now admitted, as insisted on by Mr. Sanders years ago, that the Dolomitic Conglomerate does not necessarily occupy the base of the Keuper, but is mainly a deposit of hill-talus, which has been incorporated with the finer deposits of the old Triassic lake as the several palæozoic islands gradually became submerged. The great blocks which fell from the old cliffs were formerly regarded as proofs of glacial agency, and there are persons who still believe, more especially with respect to the Permian breccias, that such rocks are indicative of a glacial origin.

In the "Index-map" the Dolomitic Conglomerate and the Red Marl are thus included under the same symbol and colour. But this is also made to include the Rhætic—an arrangement which is hardly in accordance with the facts observed in the Bristol area. On a small-scale map so narrow an outcrop as that of the Rhætic could hardly be shown; yet its affinities are probably with the Lower Lias rather than with the Trias. The late Edward Wilson, whose recent death we all deplore, in his paper on the Rhætic rocks at Totterdown (*Quart. Journ. Geol. Soc.*, vol. xlvii., 1891. p. 545), showed most clearly that the "Tea-green Marls," which had previously been associated with the Rhætic, represent an upwards extension of the Red Marls of the Trias, in which the iron had suffered reduction; though there are indications of a change of conditions having set in before the deposition of the Rhætics. The black Rhætic shales which succeed usually have a sharp and well-defined base in a bone-bed with quartz pebbles, &c., indicating a sudden change of physical conditions, though perhaps no marked unconformity. In the South Wales district the Rhætic limestones are said to be largely of organic origin, and, in addition to a Rhætic fauna, to abound in the lamellibranchs so plentiful in the lowest Lias limestones (*Ann. Rep. Geol. Survey* for 1896, p. 67).

The late Charles Moore always deplored the comparative poverty of the Trias in fossils. In his last communication to the Geological Society (*Quart. Journ. Geol. Soc.*, vol. xxxvii., 1881, p. 67), he set himself to describe certain abnormal deposits about Bristol, and to institute a comparison with the region of the Mendips. He then suggested, on the faith of a sketch by Mr. Sanders, that the famous Durdham Down deposit, already inaccessible, might have been a fissure-deposit in the Carboniferous Limestone like those at Holwell. He also stated that at one time he had been inclined to regard the reptilian deposit on Durdham Down as of Rhætic age; but the discovery of teeth of *Thecodontosaurus*, identical with those of Bristol, in a Keuper Marl deposit near Taunton, induced him to refer the Durdham Down deposit to the middle of the Upper Keuper. He had arrived at the conclusion that the same genera of vertebrata are found in the Keuper and Rhætic beds, though the species, with few exceptions, are quite distinct.

But it is with the Lias that the name of Charles Moore is most intimately associated. Time does not permit me to do more than allude to the wonderful collections of Rhætic and Liassic fossils made by him from the fissure-veins of the Carboniferous Limestone, or of the treasures which are stored in the Bath Museum. There never was a more enthusiastic palæontologist, and nothing pleased him better than to exhibit the fossilised stomach of an *Ichthyosaurus*, stained by the ink bag of the cuttle-fish, on which it had been feeding, or some similar palæontological curiosity. Every one here knows how deeply the West of England is indebted to Charles Moore for his unceasing researches, and I have been thus particular in alluding to them because it was under his auspices that I first became acquainted with the geology of this part of the country thirty years ago.

Amongst more recent work in the Rhætic and Lias, I might

[1] The boring at Burford, where coal was found at a depth of 1100 feet, below a surface of Bathonian beds, at a point thirty-five miles E.N.E. of the extreme end of the Bristol Coal-field at Wickwar, is not included in this category; since it must belong to the meridional system, and is altogether outside the prolongation of the axis of Artois.

[2] (*Cf.* Irving, *Quart. Journ. Geol. Soc.*, vols. xliv., 1888, p. 149, xlviii., 1892, p. 68, and xlix., 1893, p. 79; and Hull, *op. cit.* vol. xlviii., 1892, 60).

mention papers by Mr. H. B. Woodward and Mr. Beeby Thompson, each in explanation of the arborescent figures in the Cotham Marble. The latter revives an old idea with modifications, and his theory certainly seems plausible. Mr. H. B. Woodward's Memoir of 1893 does full justice to the Lias of this district, and much original matter is introduced.

It is, however, in the Inferior Oolite that the most important interpretations have to be recorded since the days when Dr. Wright and Prof. J. Buckman endeavoured to correlate the development of the series in the Cotteswolds with that in Dorset. To this subject I alluded at considerable length in my address to the Geological Society in 1893, pointing out how much we owed in recent years to the late Mr. Witchell and to Mr. S. S. Buckman. In the following year appeared Mr. H. B. Woodward's Memoir on the Lower Oolitic Rocks of England ("Jurassic Rocks of Britain," vol. iv.), wherein he did full justice to the work of previous observers. Meantime Mr. Buckman has not been idle, and his paper on the Bajocian of the Sherborne district (*Quart. Journ. Geol. Soc.*, vol. xlix., 1893, p. 479) marks the commencement of a new era, where the importance of minute chronological subdivisions, based upon the prevailing ammonites, is insisted on with much emphasis. This system he considers to be almost as true for the Inferior Oolite as for the Lias.

There can be no doubt that its application has enabled Mr. Buckman to effect satisfactory correlations between the very different deposits of the Cotteswolds and those of Dorset and Somerset. In subsequent papers also he brings out an important physical feature, viz. the amount of contemporaneous denudation which has affected deposits of Inferior Oolite age in this country. This serves in part to explain the absence of well-known beds in certain areas. For instance, in the Cotteswolds contemporaneous erosion has, prior to the deposition of the Upper *Trigonia*-grit, cut right through the intervening beds, so as to produce in the neighbourhood of Birdlip a shelving trough 6 miles wide and about 30 feet deep. Thus the extensively recognised overlap of the *Parkinsoni*-zone is accentuated in many places.

We have a further instance of good work in the case of Dundry Hill. An inspection of the 1-inch Survey map would lead one to suppose that the Inferior Oolite there rests directly on the Lower Lias. Recently, owing to the investigations of Messrs. Buckman and Wilson,[1] this apparent anomaly has been removed, whilst beds of Middle and Upper Lias age, and even Midford Sands have been recognised. In this way the authors claim to have reduced the thickness assigned to the Inferior Oolite on Dundry Hill by about 100 feet. In the paper above quoted the vicissitudes and faunal history of the Inferior Oolite from the *opalinus*-zone to the *Parkinsoni*-zone inclusive are shown with much detail; whilst the position of the chief fossil-bed in time and place has been well established. The general resemblance of the Dundry fossils to those of Oborne, which I could not fail to notice in working out the Gasteropoda of the Inferior Oolite, now admits of explanation. Although the quondam *Humphriesianus*-zone is richly represented, yet the particular *Humphriesianum*-hemera is held to be absent at Dundry. But if there is a *Sowerbyi*-bed anywhere it should serve to connect these two localities, where, according to Mr. Buckman's phraseology, the principal zoological phenomenon is the acme and paracme of Sonninineæ.

Mr. Buckman, as we have seen, is no longer satisfied with the old-fashioned threefold division of the Inferior Oolite, and his time-table includes at least a dozen hemeræ, with prospect of increase. Granting that it would have been difficult to solve the Dundry problem without a detailed knowledge of ammonite horizons, there arises the question as to the utility of such minute subdivisions for the purposes of general classification. Mr. Buckman has earned the right to put forwards, if he pleases, the several stratigraphical rearrangements in which from time to time he indulges. The Inferior Oolite has been his especial playground, and, as the kaleidoscope revolves, this formation is perpetually made to assume different proportions, even to the verge of extinction. But this practice is not without its disadvantages; whilst the invention of new names tends to clog the memory, and the novel use of old ones is apt to produce confusion.

We have not quite finished with Dundry yet, since that classic hill serves to illustrate in Mesozoic times a peculiarity of which I have already pointed out two notable instances in this district, where an abrupt and seemingly unaccountable difference is observed in beds which are approximately synchronous. The problem to be solved is this—why does the fossiliferous portion of the Inferior Oolite on Dundry Hill resemble that of the neighbourhood of Sherborne, both in lithology and fossils, rather than that of the Cotteswolds, only a few miles distant?

Nine years ago Mr. Buckman offered an ingenious solution of this difficulty (*Proc. Cottes. Club*, vol. ix., 1890, p. 374), though his recent investigations at Dundry, and especially his appreciation of the effects of contemporaneous erosion, may have caused him to alter his views. Like most people who wish to account for strong local differences, he placed a barrier of Palæozoic rocks between Dundry and the southern prolongation of the Cotteswold escarpment. At that time it was not fully realised that the Inferior Oolite in the Bath district is, for the most part, limited to the *Parkinsoni*-zone, so that the comparison was really being made between beds of different age as well as different physical conditions. The question resolves itself into one of local details, which are not suited for a general address. Still, I think it may be taken for granted that, notwithstanding the east-and-west barrier of the Mendip range, which acted effectually previously to the *Parkinsoni*-overlap, there was in some way a communication by sea between Dundry and Dorsetshire, more especially during the *Sowerbyi*-stage, and this most probably was effected round the western flank of the Mendips. Thus, without acceding to the necessity for a barrier facing the southern Cotteswolds, we may readily believe that much of the Inferior Oolite of Dundry Hill is to be regarded as an outlying deposit of the Anglo-Norman basin. If this be so, it is difficult to avoid the conclusion that the low-lying area of the Bridgewater flats was, during part of the Inferior Oolite period, occupied by a sea which was continuous from Sherborne to Dundry, and that, although the barrier of the Mendips was interposed, communication was effected round the west flank of that chain. This would make a portion of the Bristol Channel a very ancient feature.

We must now take a wide leap in time, passing over all the rest of the Jurassics, and just glancing at the Upper Cretaceous system, which reposes on the planed-down surface of the older Secondary rocks. The remarkable double uncomformity is nowhere better shown than in the south-west of England. Some of the movements of the older Secondary rocks, prior to the great revolution which brought the waters of the Cretaceous sea over this region, have been successfully localised by Mr. Strahan, more especially in the south of Dorset.

Owing to Tertiary denudation the Chalk in this immediate district has been removed, and we have no means of judging the relations of the Cretaceous deposits to the Palæozoic rocks of Wales. If we may judge by results recently recorded from Devonshire (*cf.* Jukes-Browne and Hill, *Quart. Journ. Geol. Soc.* vol. lii., 1897, p. 99), the Lower Chalk especially undergoes important changes as it is traced westwards, and generally speaking terrigenous deposits seem more abundant in this direction. At the same time the more truly oceanic deposits, such as the Upper Chalk, appear to be thinning. As regards the possible depths of the Cretaceous sea at certain periods, we are supplied with some interesting material in Mr. Wood's two papers on the Chalk Rock (*Quart. Journ. Geol. Soc.*, vol. lii., 1897, p. 68, and vol. liii., 1898, p. 377), which has been found especially rich in Gasteropoda at Cuckhamsley, near Wantage.

Tertiary, Pleistocene, and Recent.—Although the Tertiaries of the Hampshire basin are within the "Index-map" which we have been considering, they may be regarded as beyond our sphere. Some of the gravels of Dorsetshire, which have gone under the name of plateau gravels, are held by Mr. Clement Reid to be of Bagshot age. Many of the higher hill gravels most likely date back to the Pliocene, and even further, and represent a curious succession of changes, brought about by meteoric agencies, where the valley-flat of one period, with its accumulated shingle, becomes the plateau of another period—an endless succession of revolutions further complicated by the Pleistocene Cold Period, which corresponds to the great Ice Age of the north.

In the more immediate neighbourhood of Bristol, since some date in Middle Tertiary time, the process of earth-sculpture, besides laying bare a considerable amount of Palæozoic rock,

[1] *Quart. Journ. Geol. Soc.*, vol. iii., 1897, p. 669. *Cf.* also *Proc. Brist. Nat. Soc.*, vol. viii., 1897, pt. ii. p. 188.

has produced both the Jurassic and Cretaceous escarpments as well as the numerous gorges which add so much to the interest of the scenery. These phenomena have been well described by Prof. Sollas (*Proc. Geol. Assoc.*, vol. vi., 1881, p. 375), when he directed an excursion of the Geologists' Association in 1880. Should any student wish to know the origin of the gorge of the Avon at Clifton, for instance, he will find in the Report an excellent explanation of the apparent anomaly of a river which has been at the trouble of sawing a passage through the hard limestone, when it might have taken what now seems a much easier route to the sea by way of Nailsea.

The origin and date of the Severn valley is a still bigger question, and this was broached by Ramsay, some five-and-twenty years ago, in a suggestive paper on the River Courses of England and Wales (*Quart. Jour. Geol. Soc.*, vol. xxviii., 1872, p. 148). He there postulates a westerly dip of the chalk surface, which determined the flow of the streams in a westerly direction towards the long gap which was being formed in Miocene times, near the junction of the Mesozoic with the Palæozoic rocks. The still more important streams from the Welsh highlands had no doubt done much towards initiating that gap; and by the end of the Miocene period, if one may venture to assign a date, the valley of the Severn, which is one of the oldest in England, had already begun to take form, though many of the valleys of Wales are probably much older.

We may now be supposed to have arrived at a period when the physical features of this immediate district did not differ very materially from what they are at present. The great Ice Age was in full force throughout Northern Europe, and, according to views which meet with increasing favour, the German Ocean and the Irish Sea were filled with immense glaciers. What was taking place at that time in the estuary of the Severn?

This is a case which requires the exercise of the scientific imagination, of course under due control. There is probably nothing more extraordinary in the history of modern investigation than the extent to which geologists of an earlier date permitted themselves to be led away by the fascinating theories of Croll. The astronomical explanation of that "will o' the wisp," the cause of the great Ice Age, is at present greatly discredited, and we begin to estimate at their true value those elaborate calculations which were made to account for events which in all probability never occurred. Extravagance begets extravagance, and the unreasonable speculations of men like Belt and Croll have caused some of our more recent students to suffer from "the nightmare."

Nevertheless Croll, when he confined his views to the action of ice, showed himself a master of the subject, and his suggestions are often worthy of attention, even when we are not convinced. Writing in the *Geological Magazine* in 1871, he points out that the ice always seeks the path of least resistance; and he refers to the probability that an outlet to the ice of the North Sea would be found along the natural hollow formed by the valleys of the Trent, the Warwickshire Avon, and the Severn. Ice moving in this direction, he says, would no doubt pass down into the Bristol Channel and thence into the Atlantic. Again (*op. cit.* Dec. 2, vol. i., 1874, p. 257), referring to the great Scandinavian glacier, he says, "it is hardly possible to escape the conclusion that a portion of it at least passed across the south of England, entering the Atlantic in the direction of the Bristol Channel." These views were not based on any local knowledge, but merely on general considerations. The problem as to whether there are any traces of the passage of such a body of ice in the basin of the lower Severn must be worked out by local investigators. Irrespective, too, of the hypothetical passage of a lobe of the North Sea glacier, we are confronted by a much more genuine question, namely, what was the possible termination towards the south of the great body of ice with which our more advanced glacialists have filled the Cheshire plain?

A recent president of the Cotteswold Field Club, of whom, unfortunately, we must now speak as the late Mr. Lucy, took a lively interest in the Pleistocene geology of the district, and his papers in the *Proceedings* of the Cotteswold Field Club have always attracted attention. His map of the distribution of the gravels of the Severn, Avon, and Evenlode, and their extension over the Cotteswold hills, prepared in conjunction with Mr. Etheridge, is a valuable contribution to the history of the subject (*Proc. Cottes. Nat. Club*, vol. v. pt. ii., 1869, p. 71). Again he wrote on the extension of the Northern Drift and Boulder-clay over the Cotteswold Range (*op. cit.* vol. vii. pt. i., 1878, p. 50), and on this occasion described the interesting section in the drifts presented by the Mickleton tunnel. In his previous paper, Mr. Lucy had carried the drifts with northern erratics to a height of 750 feet, but he now claimed that "the *whole* Cotteswold Range had ceased to be dry land at the time the Clays and Northern Drifts passed over it." We perceive from this passage that Mr. Lucy was a "submerger," and in this respect differed from Croll, who most probably would have attributed the phenomena to the action of his great ice-lobe traversing the south of England.

The question which more immediately concerns us relates to the value of the evidence which would require either a glacier or a "great submergence" to account for these things. The alleged phenomena are in many cases capable of other interpretations. We have the authority of Mr. Etheridge that little or no true Boulder-clay occurs in the Cotteswold area (*Proc. Cottes. Nat. Club*, vol. xi., 1893, p. 83). On the other hand, the distribution of much of the erratic gravel is probably due to agencies of earth-sculpture long anterior to the great Ice Age. There remains one special piece of evidence adduced by Mr. Lucy in favour of his contention, and this he considered of so much importance that it formed the principal part of the subject of his annual address to the Field Club on quitting the chair in 1893 (*Proc. Cottes. Nat. Club*, vol. *cit.*, p. 1).

He there referred more especially to the discovery *in* the Inferior Oolite, on Cleeve Cloud, of quartzose sand and of a boulder of a similar character to some described in his previous papers. The sand and the boulder, he says, belong to the period of the great submergence. Similar sand also appears in several places on the hillside. He had previously recorded boulders of Carboniferous Limestone, Millstone Grit, &c., in the northern Cotteswolds, but not at so great an elevation. He further proceeds to account for the absence of striæ, and of the fact that the Cotteswold rocks are not *moutonnée*, on the supposition that the soft oolites would not retain striation, but would be crushed by pressure. Consequently he claims the top of Cleeve Cloud as a fine example of "glacial denudation," whatever that may mean. The boulder from Cleeve Cloud is now in the Gloucester Museum, and might well become a bone of contention between the submerger and the glacialist as to how it got into its elevated position of over 1000 feet. Fortunately there is a third explanation, which, if it be correct, shows how dangerous it is to build theories, as well as houses, upon sand. Other distinguished members of the Cotteswold Club are of opinion that the whitish sands on Cleeve Common belong to the "Harford Sands," which constitute an integral part of the Inferior Oolite itself. There may be some difference of opinion as to the concretionary nature of the boulders, though these may well be nothing more than the "doggers," or "pot-lids," so characteristic of calcareous sandstones. Mr. Winwood believes that "the so-called foreign boulder" in the Gloucester Museum evidently came from the "Harford Sands."

So far, therefore, the evidences of glacial action in the Cotteswolds do not rest on a very sure foundation. Yet the Severn valley separates that range from an area on the west, where there are clear evidences of local glaciation, as described in the "Annual Report of the Geological Survey for 1896." Portions of this material find their way into the river bed and elsewhere as Drift which has most probably been rearranged—hence the so-called Boulder-clay and Drift in the bed of the Severn. Once more, then, in the cycle of geological time we perceive that our district lies on the confines of two distinct sets of phenomena. West of the Severn and north of the Bristol Channel the evidences of considerable local glaciation are obvious, whilst this can hardly be said of the Cotteswolds, the Mendips, or the Quantocks.

To the more recent geological history of our district it will be sufficient to allude in the briefest terms, when I remind you of the paper by Mr. Strahan on the deposits at Barry Dock, and the still later one by Mr. Codrington on the submerged rock valleys in South Wales, Devon, and Cornwall. Here we have important testimony to certain moderate changes of level which have taken place, and a picture is presented to us of the Bristol Channel as a low-lying land surface, with streams meandering through it. Thus a depression of something like 60 feet appears to be the most recent change which the geologist has to record in the estuary of the Severn.

THE TRIENNIAL INTERNATIONAL CONGRESS OF PHYSIOLOGISTS.

FOURTH MEETING.

THE fourth Triennial International Congress of Physiologists, held at Cambridge on August 23–27, was the largest assembly of the kind that has yet met. The third congress (Bern, 1895) defined the qualification for membership as "open to (1) professors and lecturers on physiology and their official assistants; (2) to members of the American Physiological Society; the Physiological Society, England; Société de Biologie, Paris; Physiologische Gesellschaft, Berlin; Physiologisches Club, Vienna; (3) to ladies and gentlemen proposed by their National Committee, and accepted by the International Congress Committee." This rule was strictly observed for the present congress, and the number of members attending was two hundred and twenty-six. The press were not officially admitted to the meetings. The different nationalities represented were as follows:—Austria-Hungary and Germany, 33 members; Belgium, 9; Denmark and Sweden, 3; Egypt, 2; France, 29; Holland, 3; India, 2; Italy, 9; Japan, 4; Roumania, 2; Russia, 7; Switzerland, 9; United States, 16; Great Britain and Canada, 98.

A larger number of communications were received than on any previous occasion, and it became difficult to transact the business in the allotted time. The rule awarding preference to communications illustrated by experiment was adhered to, and the meetings were as free from mere verbal or pictorial exposition as on any previous occasion.

The official work of the congress commenced on the morning of August 23 at 10 o'clock, with a few pithy words of welcome and direction from the President, Prof. Michael Foster, Sec. R.S.

Prof. E. J. Marey (Paris) urged the necessity of creating an international committee for the unification and the control of physiological instruments employed for graphic methods. The following were appointed to serve: E. J. Marey, Paris; M. Foster, Cambridge; H. Kronecker, Bern; K. Hüerthle, Breslau; V. Frey, Zürich; E. Weiss, Paris; H. Bowditch, Boston.

Prof. Mosso (Turin) made a communication regarding mountain sickness. Mountain sickness, in his opinion, does not depend on diminution of the tension of the atmospheric oxygen, but on diminution of the carbon dioxide of the arterial blood.

Prof. A. Kossel (Marburg) communicated an important paper upon albumens. Starting from the probability that a protamine-like group of atoms is contained in the proteid molecule, and that from it by decomposition the hexon-bases arginin $C_6H_{14}N_4O_2$, histidin $C_6H_9N_3O_2$, lysin $C_6H_{14}N_2O_2$ arise, he with Dr. Kutscher had sought for arginin and histidin in various proteids and quantitatively determined them. They had found the hexon-bases obtainable from all the proteid substances they had as yet examined, also from elastin. The amounts obtainable from the various bodies were very different; the largest proportion was obtainable from histon, the smallest from elastin; an intermediate proportion was yielded by casein and egg albumen.

Dr. J. Demoor (Brussels) gave an interesting demonstration and account of his researches upon the association centres and the cerebral localisation of the dog. He then proceeded to describe the changes found by Prof. Heger and himself in the form of the neurons of the cortex cerebri under various conditions of rest and excitation. In animals decapitated in sleep produced by ether, chloroform, morphia, &c., the cell-body of the neuron is retracted, the dendrites are moniliform, and the distribution of the spine-like appendages is irregular and in some places they are wanting. The altered neurons recover their normal aspect after elimination of the modifying agent.

Dr. J. Demoor then gave a statement of his views of the signification of the moniliform condition of the cortical neuron. He drew attention to the similarity between this condition of the brain-cells and that of the pseudopodia of certain of the protozoa. He concludes that the nerve-cell is plastic, and that the moniliform condition of its processes is a condition of contraction.

Dr. H. Wright (Montreal) contributed the account of recent observations on the effects produced on the microscopical appearance of the nerve-cell by the action of ether and of chloroform.

Prof. H. Hamburger (Utrecht) gave an account of his continued work on the influence of solutions of inorganic salts on the volume of animal cells. He finds that white blood-corpuscles and spermatozoa increase in volume when placed in hypisotonic, and shrink when set in hyperisotonic solutions. The volumetric proportion of the two component parts of the cell, its framework and the intracellular fluid, can be accurately ascertained.

Prof. Kronecker (Bern) communicated for himself and Mlle. Schilina the results of a comparison instituted between Ludwig's kymograph and Hüerthle's tonograph.

Prof. Kronecker, for himself and Mlle. Devine, reported the results of further investigation of the respiration of the heart of the tortoise. Blood free from or very poor in oxygen (saturated with H or CO) serves to nourish the perfused tortoise heart just as well, to judge by the pulse-volume, as does arterial blood. Blood saturated with CO_2 quickly reduces the performance of the heart.

Prof. Bowditch (Harvard, Boston, U.S.A.) demonstrated an ingenious apparatus for elucidating the movements of the human eye-ball. Even on the small scale on which the mechanism exhibited had been executed he succeeded in making clear his demonstration to the whole audience in the large theatre.

Dr. L. Asher (Bern) gave a communication, illustrated by experiment, on the theory of lymph production. He defended the thesis that lymph is a product of the work of the organs, no mere filtrate from the blood, and no mere secretion from the cells of the walls of the blood-vessels. The specific activity of the salivary glands, of the thyroid, and of the digestive organs, each and all occasion increased formation of lymph.

By Dr. W. M. Bayliss (London) a demonstration was given to show the non-antagonism of visceral and cutaneous vascular reflexes.

A canula in the carotid artery of a curarised rabbit is connected to an ordinary mercurial manometer, and also, by means of a side-tube, to a wide glass tube dipping under mercury contained in a tall cylinder; the depth at which the end of the tube is situated under the mercury is adjusted so that blood just begins to escape. The leg is enclosed in a plethysmograph, and its alteration of volume traced by means of a piston recorder. If now the central end of the anterior crural, or other sensory nerve, is excited, the arterial blood pressure is prevented from rising by the escape which takes place from the tube under mercury, so that there is no opposing force to be overcome by the vessels of the leg in constricting, and accordingly the volume of the leg is seen to *diminish*. In asphyxia a similar constriction occurs.

Mr. W. M. Fletcher (Cambridge) showed the apparatus and methods employed by him in his investigation on the CO_2 discharge of excised tissues.

The titrations are performed in closed absorption chambers, and the necessary stirring and expulsion of the solutions are effected without contamination by atmospheric air. A reduplication of the apparatus allows an absorption of CO_2 to proceed in one part while estimation of that previously absorbed is conducted in the other, so that a given discharge of CO_2 may be kept under continuous observation.

The method has been used in following the survival respiration of excised tissues—mainly the leg muscles of the frog, the tortoise heart and some non-muscular tissues; and it has been found very suitable for the study of the respiration of insects.

Dr. Leonard Hill (London) brought forward interesting new experiments in pursuance of his well-known investigation of the influence of gravity of the circulation of the blood.

An eel or grass-snake is affixed to a board in the extended position, and the heart exposed. On turning either animal into the vertical position (tail downwards) the heart, after a few beats, becomes emptied of blood. On pressing the body from the tail upwards the heart immediately fills to repletion. On ceasing to compress the body the heart once more as completely empties. So soon as the animal is placed head downwards the heart engorges. This engorgement is limited by the inextensile pericardium, which in the eel is extremely strong. If a snake or eel be sunk vertically and tail downwards in a vessel of water the heart does not empty. The hydrostatic pressure of the column of water exerted on the surface of the body tends to counterbalance the hydrostatic pressure of the column of blood within the body. A chloralised tame rabbit is placed in the vertical position with the feet downwards.

Record of the aortic pressure is at the same time taken. After ten minutes or so the pressure begins to steadily fall, the respiratory pump, at first more active, gradually ceases, the animal passes into syncope, the heart is almost empty and death imminent. Compression of the abdomen will at this point immediately restore the circulation and remove the condition of syncope. The same end can equally well be attained if the body of the animal be sunk in a bath of water. In the wild rabbit, cat, dog, monkey and man, the power to resist the influence of gravity on the circulation is very perfect. The hutch rabbit is likewise restored by a bath, and in this fact it is possible to find a simple explanation of the beneficial influence of baths on the bodies of debilitated men. The hydrostatic pressure of the water not only acts on the blood vessels, but also causes the abdominal organs to float upwards. Thereby the diaphragm is raised, and the tension on the vena cava inferior relieved, that is to say, so soon as the dragging weight of the abdominal organs be removed.

Prof. Townsend Porter (Harvard, Boston, U.S.A.) communicated two important papers on the mammalian heart, entitled "The nutrition of the heart through the vessels of Thebesius," and "The beat of the isolated mammalian ventricle fed on blood-serum alone." His method was demonstrated and consists in the revivifying of the excised and washed out dog's heart by simply allowing a stream of defibrinated dog's blood to flow through it from the coronary artery.

A heart fed simply through the veins of Thebesius and the coronary veins will maintain strong, rhythmic contractions for many hours if supplied with oxygen at high tension. The absence of corpuscles was readily borne by the heart. Continued rhythmic contractions were obtained with the serum alone, so soon as the oxygen tension rose to about two atmospheres. It follows that the mammalian heart fed through the vessels of Thebesius and the coronary veins with blood-serum alone will maintain rhythmical contractions for hours when surrounded by oxygen at high tension. Isolated pieces of the ventricle beat if fed with serum through a branch of the coronary artery.

These experiments permit the conclusion that even isolated portions of the mammalian ventricle supplied through their nutrient arteries with a small quantity of serum at very low pressure will maintain rhythmical, long-continued, forceful contractions when surrounded by oxygen at high tension.

The influence of salts upon the electromobility of medullated nerve was the subject of a communication, illustrated by experiments and by lantern galvanograms, by Prof. A. D. Waller, F.R.S. (London). The method of investigation was that previously employed by the author.

Excised frog's sciatic laid across unipolar electrodes in moist chamber. Electrical response to electrical excitation at regular intervals photographically recorded before and after modification of the nerve by various salts dissolved in normal saline.

In the action upon nerve of a salt BA, the predominant moiety is B (the basic or electropositive element), *e.g.* any potassium salt is more effective than any sodium salt.

The acidic or electronegative element A is of subordinate action, *e.g.* KI> KBr.

	Strength of solution		Effect upon electrical response.
	%	*M.*	
NaBr	1·030	*m*/10	No effect.
KBr	1·190	*m*/10	Abolition in 30 mins.
KCl	0·744	*m*/10	Abolition in 30 mins.
NaF	0·840	*m*/5	No effect.
KF	1·160	*m*/5	Abolition in 8 mins.

Is the action upon nerve of a salt $\overset{+}{B}\ \overset{-}{A}$, or of an acid $\overset{+}{H}\ \overset{-}{A}$, or of an alkali $\overset{+}{B}\ \overset{-}{OH}$, that of dissociated ions?

Do *e.g.* HNO_3 act upon nerve by virtue of its electropositive H, and KOH by virtue of its electronegative OH?

Certainly not exclusively. Because *e.g.* the action of the highly dissociated *n*/10HNO_3 is not greater than that of the slightly dissociated CH_3, COOH, and the action of KOH is considerably greater than that of NaOH at equality of dilution and of dissociation. The action of the highly dissociated chlorides, bromides, &c., is not greater than that of the slightly dissociated acetates.

Data.

	Strength of solution			Effect upon electrical response.
	%	*M.*	*N.*	
H_2SO_4	0·490	*m*/20	*n*/10	Abolition in 7 mins.
HNO_3	0·630	*m*/10	*n*/10	Abolition in 15 mins.
CH_3, COOH	0·600	*m*/10	*n*/10	Abolition in 15 mins.
H_3PO_4	0·653	*m*/15	*n*/5	Abolition in 25 mins.
CH_3, CHOH, COOH	0·450	*m*/20	*n*/20	Abolition in 15 mins.
NaOH	0·200	*m*/20	*n*/20	Diminution.
KOH	0·140	*m*/40	*n*/40	Abolition in 8 mins.

Prof. E. Wertheimer (Lille) demonstrated observations, made with M. Lepage, that the influence of the accelerator nerves on the heart is much less, in the dog, during expiration than during inspiration.

Prof. Grützner (Tübingen) demonstrated (1) a tambour by means of which the slightest alteration in the pitch of a sung note can be visually demonstrated before an auditorium; (2) a method of analysis of a compound note by means of interference established by stopped tubes of different lengths; (3) his graphic record of induction currents upon paper.

Dr. J. N. Langley, F.R.S. (Cambridge), demonstrated his discovery of the possibility of obtaining an experimental union between the nerve-fibres of the vagus nerve and the sympathetic nerve-cells of the superior cervical ganglia. The vagus and sympathetic nerves were ligatured with horse-hair. On August 23 sixty-four days had elapsed since the end of the vagus was joined to the sympathetic nerve. The vagus nerve was then cut near the skull, and its peripheral end stimulated. Regeneration had taken place; the stimulation of the vagus caused opening of the eye, retraction of the nictitating membrane, dilation of the pupil, contraction of the vessels of the ear, and more or less of the other effects ordinarily produced by stimulating the cervical sympathetic. The injection of 20 milligrams of nicotin temporarily prevented the vagus from producing any of these effects, but did not prevent stimulation of the superior cervical ganglion from producing them. This result shows in the clearest manner that the specific effect of the excitation depends upon the specific character of the peripheral ending, not on the character of the central conducting paths.

Prof. Heymans (Ghent), gave experiments upon physiological and artificial disintoxication. The simple nitrils are within the organism decomposed and eliminated in the form of sulphocyanide. This physiological disintoxication, acting under the intervention of sulphuretted organic bodies, is much increased by the administration of certain compounds of sulphur such as the hyposulphites, &c. These sulphur compounds prevent or remove the poisonous effects of a dose of the nitrils many times that sufficient to kill.

Prof. Sherrington, F.R.S. (Liverpool), demonstrated his discovery of inhibition of the tonus of a skeletal muscle by the excitation, either electrical or mechanical, of the antagonist muscle. The phenomena has bearing upon spinal coordination for volitional and other kinds of movement. The experiment shown dealt with the antagonistic flexors and extensors of the knee-joint. The stretching of a muscle produced by the contraction of its antagonist may excite (mechanically) the sensorial organs in the muscle that is under extension; in this way a reflex of pure muscular initiation may be started. The experiment proved that electrical excitation of the central end of an exclusively muscular nerve produces inhibition of its antagonist. (1) The central end of the severed hamstring nerve was faradised. This nerve contains sensory nerve-fibres from the flexor muscles of the knee. The effect of these on the extensor muscles of the knee was seen (α) in elongation of those muscles, (β) in temporary diminution of the knee-jerk. (2) The exposed flexor muscles detached from the knee, and therefore incapable of mechanically affecting the position of the joint, were then stretched or kneaded. This produced reflex elongation of the extensor muscles of the knee and a temporary diminution of the knee-jerk. It may therefore be that reciprocal innervation, which Prof. Sherrington has pointed out to be a common form of coordination of antagonistic muscles, is secured by a simple reflex mechanism, important in its execution being the tendency for a muscle to produce its own inhibition reflexly by mechanical stimulation of the sensory apparatus in its antagonist.

Prof. O. Frank (Munich) demonstrated methods of recording the action of the cardiac muscle both isotomically and isometrically.

Prof. Gotch, F.R.S., and Mr. G. J. Burch (Oxford) showed photographs of the electrical response of nerve to excitation. The results obtained have been: Biphasic effects indicated by a rapid displacement in one direction which is followed by one in the other. Examples of these are (1) effect in uninjured fresh nerve with both contacts upon the surface, (2) effect in excised nerve kept for twenty-four hours in 0·6 per cent. NaCl. Monophasic effects indicated by a rapid displacement returning very slowly and exhibiting a second effect of similar direction but of slow development, the negative after-effect obtained when the functional capacity of the tissue under the distal contact is so lowered that it is incapable of undergoing the change which produces the excitatory electrical response. Biphasic effects with prolonged second phase when the functional capacity of the tissue is low; the records show an initial small displacement followed by a prolonged one of opposite sign, *i.e.* a positive after-effect. The nerve when excited by a rapid series of stimuli gives a series of independent spikes; the injured nerve gives a series of displacements which are superimposed; the after-effect not having subsided when the second response occurs.

Prof. A. B. Macallum (Toronto) brought forward and illustrated by demonstration his method for detection and localisation of phosphorus in animal and vegetal cells, &c. The use of pyrogallol for this purpose is not free from objection, and a reagent was sought which would definitely distinguish between the molybdate and phospho-molybdate of ammonia. This reagent was found in phenylhydrazin hydrochloride in a 1–4 per cent. aqueous solution which gives a dark-green reaction with the phospo-molybdate compound, but none with molybdate of ammonia in the presence of nitric acid. The nitric-molybdate reagent is allowed to act for some hours at a slightly elevated temperature on the sections of tissue, which are then transferred to the solution of phenyl-hydrazin hydrochloride. To prevent the confusion which might result from the presence of lecithin, the latter must be extracted with hot alcohol, frequently renewed, for five hours, and the presence and amount of inorganic phosphates are indicated by the early appearance of the reaction and its extent.

The method has resulted in demonstrating the presence of "masked" phosphorus in the chromatin of all animal and vegetable cells, in nucleoli, in the anisotropic substance in muscle fibre, in the prozymogen and zymogen of pancreatic cells, in the colloid material of the thyroid, in the outer limbs of the rods and cones, in pyrenoids of the Protophyta, &c. It also shows that in non-nucleated organisms like the Cyanophyceæ and *Saccharomyces* the phosphorus-holding substance, or nucleo-proteid, although sometimes in the form of granules or spherules which have been taken for nuclei, is frequently dissolved in the cytoplasm.

Prof. Boruttau (Göttingen) communicated a paper upon recent advances in electro-physiology. After speaking of the methods of investigating the course in time of the action-current of nerve, and especially of the use of combining photographic records with rheotom experiments, he discussed the biphasic and monophasic action-currents of frog's nerve, their modifications in electrotonus, their alteration and abolition under ether narcosis and in cold, their increase by CO_2, the alterations effected in the electrotonic state by ether and by CO_2, and the phenomena of the curare preparation.

Prof. J. B. Sanderson (Oxford) communicated a paper on the duration of the monophasic variation of the sartorius muscle of the frog.

Dr. Theodore Beer (Vienna) brought forward an important communication, richly illustrated by experiment, upon the accommodation of the eye in various species of the animal kingdom. In order to adapt an eye to a range of objects at different distances, *two* plans are employed. In the first the curvature of the refracting surface is made adjustable; in the second the distance of the refracting surfaces from the receptive screen is adjustable. The adjustment of the curvature is exclusively of increase of the curvature, affording thus an active accommodation for near vision. This exists in mammals, birds, lizards, crocodiles, tortoises, and in a few snakes. Throughout the above-named forms the means by which the adjustable increase of curvature is obtained is by the active contraction of a muscle slackening the suspensory apparatus that under the resting condition of the muscle keeps to some degree flattened the anterior surface of the lens.

In cephalopods and the bony fishes the eye is when at rest in focus for objects near at hand. In these forms the adjustment is for distant objects, and is brought about by the retreat of the lens towards the retina. In amphibia and snakes—or rather in such of them as possess any visual accommodation—there exists an active accommodation for near vision executed by an advance of the lens from the retina. In the bony fishes a special muscle (*Retractor lentis*, Beer) drags the lens backwards towards the retina. In the cephalopods, amphibia and snakes, alterations in intraocular pressure, brought about by contraction of circularly-arranged muscle-fibres, play an important part. Among mammals, reptiles, amphibians, and fish there are certain species that have no power of visual accommodation; these are for the most part nocturnal species and forms with narrow, even slit-like pupils (great sensitivity to light). Some of the tortoise-tribe, which dive under water, not only counterbalance the loss of the corneal refracting surface thus occasioned, but even under water accommodate for near vision.

Prof. Halliburton, F.R.S., and Dr. F. W. Mott, F.R.S. (London) demonstrated the influence of cholin, neurine, and some allied substances upon the arterial blood-pressure. In certain diseases of the central nervous system the cerebrospinal fluid becomes laden with toxic substances of this class, and it is in prosecution in that direction that the researches of Profs. Halliburton and Mott are especially suggestive.

Prof. E. Weymouth Reid, F.R.S., and Dr. J. S. Macdonald (Dundee) demonstrated experiments illustrative of their study of the electromotive changes in the phrenic nerve.

Electromotive changes in the phrenic nerve can be demonstrated to accompany the groups of nervous impulses periodically generated in the respiratory centre. By the cut end and a point about a centimetre central thereto, the nerves are suspended on "cable" non-polarisable electrodes, free of the tissues of the neck, and are led off to the galvanometer (without compensation) or capillary electrometer. A single nerve, or, taking symmetrical points on the two sides, both "in parallel" (galvanometer) or "in series" (electrometer) may be used for experiment. The characteristic effects have been seen as long as two hours after putting the nerves in circuit. Intermittent electrical discharges (negative variations of the demarcation current) are observed and can be abolished by ligature of the nerve with moist thread above the proximal electrode. If the animal is curarised and artificial respiration set up, it is found that the magnitude of the discharge is directly affected by the supply of air, so that with over-supply there is cessation of discharge, with under-supply or stoppage of pump, asphyxial increase.

Prof. Sherrington, F.R.S. (Liverpool), with Dr. Hering (Prague), gave a convincing demonstration in the monkey (*Macacus*) of inhibition of the contraction of voluntary muscle evoked by electrical excitation of certain points of the *cortex cerebri*. This inhibition, producing relaxation of volitional muscles, was shown to occur regularly in the evocation of co-ordinated movements from the cerebral cortex. The relaxation of a muscle is not obtained by excitation of the same point of cortex as that whence its contraction is elicitable, but is obtainable from the same point of cortex as that whence contraction of its antagonist can be obtained. A distance of more than a centimetre sometimes separates the points whence contraction and relaxation of one and the same muscle can respectively be obtained. Besides this reciprocal innervation of the true antagonists, evidence was demonstrated of a more complex relationship between different muscle groups; relaxation of some muscles and contraction of others was shown to exist in cases where the physiological connection between the two different activities is not obvious or easily intelligible.

Dr. Maurice Nicloux (Paris) showed that if carbonic oxide is made to pass over iodine anhydride maintained at a temperature of 100°–150°, the carbonic oxide is oxidised, and passes off in the form of carbonic anhydride at the same time that the iodine is set free in corresponding quantity. This reaction occurs whatever be the dilution of CO in the air, even if the dilution be 50,000. Search for traces of CO becomes, therefore, simple, rapid and exact. There is, therefore, a certain amount of CO normally in the blood. The average quantity seems to be 1·4 cc. per litre of blood. M. Desgrez has shown that chloroform in contact with an aqueous solution of potassium produces some carbonic oxide. The general reaction of the blood and tissue fluids being alkaline, Nicloux and Desgrez have inquired whether this decomposition does actually occur in the organism. Experiment has shown that it does.

Prof. Marey (Paris) showed a new series of studies in chronophotography.

A conjoint communication was made by Prof. Waller, F.R.S., and Miss Sowton (London), on the action upon isolated nerve of muscarine, chlorine and neurine, commenced at the instance of Prof. Halliburton. Comparative experiments were made with the hydrochlorides of these two bodies. Occasion was taken to bring into the comparison the effect of muscarine, which in previous experiments at a strength of 1 per cent. had showed itself to be of doubtful action upon nerve. Choline as compared with neurine is inert in relation to nerve. 4 per cent. solution of choline produces no effect, whereas the electromobility of nerve is abolished by neurine at 4 per cent., at 2 per cent., at 1 per cent., and markedly diminished at 0·5 per cent. As regards the substance of cerebro-spinal fluid, if the issue be narrowed to an alternative between choline and neurine, there can be no doubt that neurine is absent, and therefore choline present. The muscarine used was less active upon nerve than neurine. As regards an action upon isolated nerve, the order of efficacy of the samples used was: (1) neurine, (2) muscarine, (3) choline.

Miss S. C. Sowton (London) gave an interesting report of a large series of galvanometric records of the decline of the current of injury in medullated nerve, and of the changes in its response to periodic stimulation. The work had been prosecuted chiefly in Prof. Waller's laboratory, and had for its object the study, by means of prolonged photographic records, of:—

(*a*) The progressive modifications of electromotivity described by Engelmann, viz. decline of current of injury with lapse of time, and its restoration by a fresh transverse section.

(*b*) The progressive modification of electromobility described by Waller, viz. decline of negative variation and appearance of a positive variation.

The curve of diminishing electromotivity falls convex to the abscissa. Time being taken in arithmetical progression, the residual electromotivity is in geometrical progression, with a ratio = ½ per 1 hour. The negative variation progressively diminishes during the first 2 or 3 hours, and gives place to a progressively increasing positive variation.

Dr. Bayliss and Dr. E. Starling (London) showed an influence of blood-supply on peristaltic movement. The cutting off of blood-supply from the intestine reduces the peristaltic movements after a variable interval. The intestinal inhibition due to the splanchnic may be only secondary to vascular constriction.

Dr. H. Ito (Bern) reported a research into the place of the heat-production evoked by cortical excitation.

Physical absorption of isotonic and anisotonic salt solutions was the subject of a communication by Prof. S. P. Budgett (St. Louis, U.S.A.). A dilute solution of egg-albumen placed inside the shell membrane of the hen's egg, and separated by it from a strong solution of sodium chloride, increased in volume at the expense of the latter. An explanation of this phenomenon may be of interest with regard to the intestinal absorption of hyperionic salt solutions. The membrane offers so little resistance to the dialysis of sodium chloride, that the osmotic pressure due to the latter is for the most part transmitted through, rather than exerted against, the membrane, and consequently can interfere but little with the absorption of its solvent. Added to these circumstances is the osmotic pressure exerted by the albumen on the inner side of the membrane; this force and the greater resistance presented by the membrane to the exit of water, together overbalance the lesser resistance offered by the membrane to the entrance of water, and the slight resistance to the dialysis of sodium chloride. The solution of egg albumen may be replaced by serum, by milk, by a solution of dextrin, or gum arabic, or by an even somewhat hypotonic solution of a crystalloid such as ammonium sulphate, which dialyses less readily than sodium chloride through the egg-shell membrane.

Dr. F. S. Lee (New York) gave a communication on the fatigue of muscle. He had studied the process of fatigue in the frog, the turtle, and the cat. The increase in the duration of relaxation that occurs in the frog is not found in the case of the two other species. The one essential factor in the phenomenon of fatigue is the diminution of the lifting power of the muscle. Of the two supposed causes of muscle fatigue, viz. decrease of contractile substance, and accumulation of fatigue-products with poisoning of the muscle thereby, the former plays no part in the phenomenon; the latter is the sole cause. Fatigue is a safeguard against exhaustion. Attempts to demonstrate histological differences between resting and fatigued muscle had yielded him only negative results.

Prof. W. H. Thompson (Belfast) reported observations on the diureric effects of small quantities of normal saline solution. Sodium chloride solution (·6 per cent. ·6 per cent. and ·9 per cent.) 2–4 c.c. per kilo was injected into the external saphenous vein. The quantity of urine was greatly increased, far beyond the amount injected. The urea and total nitrogen was increased when measured hour by hour, though the urine was more dilute. At first this might be thought due to absorption of water into blood-vessels causing a dilute blood. This cannot, however, be the explanation, since sp. gr. of blood in many cases is higher than normal during period of greatest diuresis. It is also not due to excretion of surplus NaCl—for in many cases this is diminished, though urine is increased, *i.e.* the two phenomena do not run parallel.

Dr. Brunton Blaikie (Edinburgh), with Prof. Gottlieb's co-operation (at Heidelberg), had examined the muscle of dogs which had been bled to death, the bleeding being of a very thorough nature. The estimation of urea was conducted according to von Schroeder's method, and *urea in crystalline form was conclusively demonstrated in all cases.*

Prof. Hagemann (Bonn-Poppelsdorf) gave an account of his researches on the actual nutritional value of the feed of the horse. Each weighed-out "feed" can be divided into *a* per cent. which is absorbed, and $100 - a$ per cent. which reappears in the fæces. The portion *a* per cent. is often regarded as digested, that is, completely usable by the organism for its nutrition. Such a view is only partly justified. From it there has to be substracted that digestion-work consumed in absorbing it, and also that part which is broken up by fermentation processes in the intestine.

Drs. F. G. Hopkins and W. B. Hope (London) dealt with the questions of the nucleo-proteids as dietetic precursors of uric acid. They confirmed Mares that after a meal the increase of uric acid in the urine is immediate and has a duration shorter than that of the increase of urea. They called attention to the difficulty of reconciling this fact with an origin from nucleins which are unaffected by the earlier (gastric) period of digestion. In testing this matter it was found that taking filtered pepsin-hydrochloric acid extracts of the thymus gland as test meals produces a large increase of uric acid, though the extracts could be shown to contain no more than traces of nuclein; whereas the administration of pure nuclein prepared from the gland gave (in the authors' experiments) no increase at all. The ascription of all uric acid production in the mammal to the breakdown of nucleins is over hasty.

Dr. Martin Hahn (Munich) gave a communication on the chemical and immunising properties of plasmines. By plasmines the author denotes the substances contained in animal cells. He pointed out that it is now possible to express from yeast-cells a cell-free juice or plasmine which ferments sugar. This yeast plasmine contains also a proteolytic enzyme. The injection of the plasmines of cholera and typhoid bacilli in the guinea-pig establishes a specific immunity against intraperitoneal infection with cholera or typhoid. The same immunity can be obtained by injecting an alcoholic precipitate of the plasmine, or a precipitate thrown down from the plasmine by acidifying with acetic acid.

Prof. Livon (Marseilles) communicated observations on the action of extract of the pituitary body upon the function of the vagus nerve, illustrated by a number of kymograms. The inhibitory action of the vagus on the heart he found to be distinctly weakened temporarily after the injection of doses of pituitary extract.

Dr. Medwedew (Odessa) reported his studies concerning the oxidation of salicyl aldehyde in tissue-extracts. The oxidising principle contained in the extracts seems to be one or several peroxidised substances that can give up their oxygen in a molecular form.

Drs. Bedart and Mabille (Lille) read a paper on the action of arsenic upon the intoxication produced by ingestion of the thyroid body. The acceleration and irregularity of heart-beat produced in the dog by feeding with thyroid gland are removed by treatment with arsenic.

Dr. de Saint-Martin (Paris) made a communication on the absorbent power of the blood for oxygen and for carbonic oxide. Setting out from the statement of Claude Bernard that carbonic oxide displaces the oxygen from the blood volume for volume, he makes use of the following method of analysing the oxygen content of the blood. In a glass bulb are placed the blood to be examined, pure CO_2, and a saturated aqueous solution of

sodium fluoride. These are well shaken, and then transferred to the gas-pump and extracted. The difference between the volume of carbonic oxide found and that introduced into the bulb gives the exact measure of the absorbing power of the blood. The addition of the sodium fluoride (Arthus, 1892) stops all consumption of oxygen, and is helped towards that end by the agitation of the blood with CO. The latter produces complete displacement of the oxygen, and thus ensures total extraction of the oxygen by the pump. Finally the carbonic oxide fixed by the hæmoglobin can be removed by adding to the residue an equal volume of saturated solution of tartaric acid. This method avoids the error due to the decomposition of the oxyhæmoglobin remaining incomplete, and to the consumption of a certain amount of oxygen by the blood itself during manipulation. By his new method De Saint-Martin arrives at the result; the power of hæmoglobin to absorb CO is very variable, altering even from day to day in the same individual. To estimate the respiratory power of the blood, it is necessary therefore not merely to determine the quantity of hæmoglobin in it, but to determine the absorbing power of the hæmoglobin. It follows, further, that according to De Saint-Martin estimations of the amount of hæmoglobin in blood based upon its absorbing power are quite untrustworthy.

Dr. C. Phisalix (Paris) demonstrated the existence of an oxydase in the skin of certain batrachians. The skin of the frog is macerated in saline, and the juice thus obtained is placed in three tubes. The first is heated to boiling, the second is sealed in vacuo, the third is left open to the air. The first and second preserve their original tint, the third turns brown, the brown colour commencing at and spreading from the surface of the fluid. At the end of five days the whole fluid is a deep brown. The fresh juice turns tincture of guiacum blue.

Prof. Moussu (Alfort) communicated a paper upon the functions of the thyroid and parathyroid bodies. Extract of parathyroid has no alleviative effect upon the symptoms of thyroid cachexia.

Prof. E. Schäfer, F.R.S (London), gave an interesting paper on the alleged sensory functions of the motor cortex cerebri. The conclusion drawn by Munk is that "Schiff was right in affirming that the parietal lobe is the tactile sphere as the temporal is the auditory and the occipital the visual sphere." Munk's view of the question has been adopted in this country by Mott, who states that his experiments "support Munk's conclusions that in the 'motor area' the sensation of touch and of pressure of the corresponding extremities is perceived." The chief method employed by Mott for testing tactile sensibility was the application of a steel spring clip to the skin (Schiff's clip test). This method is completely illusory. Schäfer found that an animal which will apparently disregard the constant pressure of even a strong clip on the skin of a paralysed limb, will, nevertheless, instantly take notice of a light touch, or of a light stroking with a straw upon the same limb. Experiments, thirty in number, have been made. The result has been to show that the assertions above quoted are entirely erroneous: that, in fact, complete voluntary motor paralysis of a part may be produced by a cortical lesion without perceptible loss of tactile sensibility. It cannot, therefore, be the case that the motor paralysis which is produced by a lesion of the Rolandic area is due to a sensory disturbance. And it also follows that tactile sensibility is not localised in the same part of the cortex from which voluntary motor impulses directly emanate. Hemianæsthesia sometimes results from an extensive lesion of the motor cortex; this is, however, not local but general, and is due to the vascular and mechanical disturbance produced upon the whole side of the brain by the establishment of the lesion. That this is the case is shown by the fact that it is generally accompanied by hemiopia. Five experiments were made in the following manner. Having exposed the upper Rolandic region in a monkey, the leg-area in the gyrus marginalis is completely severed by a cut passing as nearly as could be determined as far down as the calloso-marginal sulcus, and at any rate deep enough to sever all the fibres passing from the cortex to the centrum ovale. In no case did this lesion produce anything more than quite a temporary sensory disturbance, not to be detected after a day or two; and even this was exceptional. The opposite leg was always completely paralysed, and gave no sign of voluntary motion, although after a time "associated movements" returned. The animal would at once look round if the foot were touched ever so lightly with a straw, although it would usually not remove a clip. After a variable period a second operation was performed upon the same region. In this the cut was extended more deeply, so as to sever as much as possible of the gyrus fornicatus; which was in some cases removed, in others left *in situ*, but with its coronal fibres cut. *In every case no perceptible effect was produced* by this second operation. The amount of actual severance of the fibres of the gyrus fornicatus varied, but in two it was considerable; and since in none of these cases could any anæsthetic effect of such severance be detected, it must be admitted that the result militates against the view that the gyrus fornicatus is the centre for tactile sensibillty. The result is also fatal to the view which has been taken of the experiments on the gyrus fornicatus by H. Munk, and accepted by Mott, that the anæsthesia found was due to injury of the adjacent motor region. For in the experiments here described, the adjacent motor region was not only injured, but actually removed, without the production of any anæsthesia, although the lower limb was completely paralysed.

Dr. G. Mann (Oxford) gave a paper on higher and lower centres in the mammalian cerebrum.

Prof. A. Vitzou (Bucarest) reported recovery of sight in monkeys after total ablation of the occipital lobes. The blindness produced by the operation was only temporary, although at first complete. The chief evidence that the animals see is their power to avoid obstacles. The removal of the angular gyri renders the blindness longer persistent.

Drs. Moore and Reynolds (London) have examined the rate of transmission of nerve-impulses through the spinal ganglia. They find no appreciable delay caused by the interposed nerve-cell.

Prof. Verworn (Jena) addressed the meeting on the subject of so-called hypnosis in animals. Tonic contraction of muscles was, he maintained, the most characteristic symptom of the condition.

Dr. Wybauw (Brussels) found that continued perfusion of the heart with normal saline destroyed the inhibitory effect of the vagus.

Prof. Boyce and Dr. Warrington (Liverpool) gave an illustrated summary of the physiological structure of the brain of the fowl. Certain tracts degenerate from the pallium into underlying parts, namely, into the thalamencephalon and mesencephalon. The anterior commissure degenerates severely after removal of one hemisphere. Fibres arise from the thalamic nuclei and form a commissure comparable with Gudderi's commissure. From the mesencephalon an ascending tract was traced to near the junction of optic thalamus with corp. striatum, and descending tracts into the ventral and lateral columns of the spinal cord. In the cord itself ascending tracts can be distinguished traceable into cerebellum and into the upper part of the cord, and descending in the ventral and lateral regions of the cord. Ferrier's results on excitation of the surface of hemisphere were confirmed.

Prof. v. Frey (Zürich) communicated the results of his work on the adequate stimulation of touch nerves. The intensity of the just noticeable stimulus depends upon the size of tactual surface; the pressure that has to be applied per unit of surface is greater the larger the continuous area of surface simultaneously tested. It is not the pressure *per se* which determines the stimulation, but the difference of pressure obtaining from point to point within the skin.

Profs. Langlois and Richet (Paris) gave an account of observations upon the resistance of diving animals to asphyxia. A hen dies after one minute's immersion, but a duck does not suffer from an immersion of even fifteen minutes. A duck with occluded trachea shows asphyxia in four minutes if left in the air; if plunged in water at 20° C. it shows asphyxia only after a quarter of an hour. After paralysis of the vagus by atropine, plunging does not delay the asphyxia. The plunging in water appears to reflexly restrain the respiratory combustions.

Prof. Lanlainé (Toulouse) brought forward experiments which show that in all cases and under all conditions the heat produced by an animal is equal to the heat calculated from the oxygen consumed by the animal in the time of the experiment.

Dr. R. Magnus (Heidelberg) reported an investigation upon the reaction of the pupil of the isolated eel's eye under various homogeneous lights. A Rowland's grating spectrum was used. The two isolated eye-balls from the same eel, the pupils of which under similar conditions are of similar size, were exposed for twenty minutes, and then photographed by a flash-light. The curve of the intensity of reaction agrees with the absorption curve of the eel's rod-purple. This argues against an effect

being produced upon the contractile tissue of iris mediately through its yellow-brown pigment.

Prof. Delezenne (Montpellier) answered the question whether the congestion of the limbs and skin produced in asphyxia is due to the active dilatation of the blood-vessels of those parts or mechanical dilatation by the blood driven out of the viscera by the asphyxial contraction of the visceral blood-vessels. The femoral vessels of a limb severed, with the exception of its nerves, from the rest of the animal are connected with the circulation of a second animal. Asphyxia, excitation of sensory nerves, &c., still produce under those circumstances increase in the volume of the limb and rise of its temperature.

Dr. O. Grünbaum (Cambridge), showed experiments demonstrating the impermeability of the salivary glands to molecules above a certain weight.

Prof. Bédart (Lille) read a paper on production of mammary secretion by cutaneous Franklinisation.

Dr. D. Noël Paton (Edinburgh) contributed a communication upon the distribution of nitrogen and of sulphur in the urine of the dog. In the course of an investigation on the influence of diphtheria toxin on metabolism it was found that the increase in ammonia nitrogen observed in febrile conditions in the human subject is absent. It was further found that the increase in the excretion of nitrogen was out of proportion to the increase in the excretion of SO_3 of sulphates. It was then proved that the neutral sulphur of the urine is increased, and that thus the total sulphur excretion is proportionate to the excretion of nitrogen. This absence of increase in the sulphuric acid production seems to explain the absence of increase in the formation of ammonia in the dog.

Dr. J. S. Haldane, F.R.S. (Oxford), showed his method of liberating and estimating the amount of oxygen in the blood by means of potassium ferricyanide.

Dr. Arthur Biedl (Privat-docent, Vienna) demonstrated that the blocking of the thoracic duct, or the removal of the lymph from it by a cannula, produces a glycosuria, even in fasting animals. This glycosuria can be set aside by the injection of lymph serum into the veins. Pancreatic diabetes is increased, not removed, by ligating the thoracic duct.

Prof. Denys (Louvain) brought forward experiments towards distinguishing distinct species among the leucocytes of mammals. Myelocytes ground up in serum warmed to 60° communicate to the serum an extraordinary bactericidal power. Lymphocytes, on the other hand, yield no bactericidal substance.

Prof. Graham Lusk (Newhaven, U.S.A.) pointed out that administration of phlorhizin to starving dogs produces elimination of the systemic sugars through the urine, and thereafter dextrose appears in the urine in the constant average ratio as regards nitrogen of 3·75 : 1. This removal of sugar is accompanied by a rise in proteid metalbolism as high even as 560 per cent. Such a rise has only been noted in phosphorus poisoning. The question arises, is not the high proteid metabolism due in both cases to the same cause—the non-burning of the carbohydrates? In the case of diabetes the sugar is removed, in the other perhaps converted into fat. If this be true, and if phosphorus be given in phlorhizin diabetes, then perhaps the urinary sugar might decrease in quantity, because the proteid sugar is being converted into fat. Experiment shows that this diminution does not take place.

Prof. G. Burch (Oxford) gave a communication on temporary colour-blindness produced by exposing the eye to sunlight in the focus of a burning glass, behind a transparent screen. After fatigue by red light, the spectrum appears green, blue, and violet, the green beginning in the part that usually appears orange. After green light, the spectrum consists of red, blue, and violet, the red meeting the blue near the *b* lines. After blue light, the spectrum consists of red, green, and violet, the green meeting the violet between the F and G lines. After violet light between H and K the spectrum consists of red, green, and blue only, the blue ending midway between G and H. After orange light from D the spectrum consists of two colours only, viz. blue and violet, the blue beginning at the *b* lines. After indigo light, the spectrum consists of two colours only, namely red and green, the green ending a little beyond F. After purple light, or after indigo light followed by red light, the spectrum consists of green only, from about D to F. After indigo light followed by green light, the spectrum consists of red only, and is visible from A to about the *b* lines.

Dr. René du Bois-Reymond (Berlin) communicated for Prof. N. Zuntz an account of the construction and performances of a new ergometer, of which a working model was exhibited.

Prof. A. B. Macallum (Toronto) communicated for Dr. F. H. Scott (Toronto) some points in the micro-chemistry of nerve-cells. The Nissl granules are found to contain "organic" phosphorus as well as "masked" iron; they, therefore, probably consist in part at least of something which, like nuclear chromatin, is an iron-holding nucleo-proteid.

Communications were also brought forward by Prof. Allen, Dr. Atwater, Dr. Cohnheim, Prof. Floresco, Dr. Johansson, Miss Huie, Dr. S. Fränkel, Dr. Barnard, Prof. Bohr, Dr. Lauder Brunton, and others.

On Thursday, August 25, the honorary degree of D.Sc. was conferred upon Prof. Bowditch (Harvard), Prof. Golgi (Pavia), Prof. Kronecker (Bern), Prof. Kühne (Heidelberg), and Prof. Marey (Paris). The speeches delivered by the Public Orator in the Senate House on the occasion have already appeared in NATURE (p. 428).

Among the members of the congress not actually contributing communications were the following:—Prof. Fredericq (Liège), Dr. L. Querton (Brussels), Dr. J. H. Cameron (Toronto), Prof. Gordon (Toronto), Profs. Sandwith and Wilson (Cairo), Prof. Dastre (Paris), Prof. Doyon (Lyon), Prof. Dubois (Lyon), Prof. Jolyet (Bordeaux), Prof. Lambert (Nancy), Prof. Lortet (Lyon), Prof. Morat (Lyon), Dr. L. Olivier (Paris), Prof. Weiss (Paris), Prof. Edinger (Frankfort), Prof. Garten (Leipzig), Prof. Jaffé (Königsberg), Prof. Kühne (Heidelberg), Dr. K. Mays (Heidelberg), Prof. Hans Meyer (Marburg), Dr. V. Uexküll (Heidelberg), Dr. Anderson (Cambridge), Dr. Brodie (London), Dr. Edkins (London), Dr. Elliot Smith (Cambridge), Dr. Ewart (London), Prof. Gamgee, F.R.S. (Lausanne), Dr. Garrod (London), Dr. Gaskell, F.R.S. (Cambridge), Miss Greenwood (Cambridge), Dr. Head (London), Dr. Leonard Hill (London), Dr. W. Hunter (London), Prof. Kanthack (Cambridge), Prof. Leech (Manchester), Dr. Pembrey (London), Prof. Ringer, F.R.S. (London), Dr. Shore (Cambridge), Prof. Stirling (Manchester), Prof. Stockman (Glasgow), Prof. Einthoven (Leyden), Prof. Stokvis (Amsterdam), Dr. Hankin (Agra), Prof. Purse, (Dublin), Dr. Treves (Turin), Prof. Amaya (Tokio), Profr Mislawski (Kasan), Prof. Wedenskii (St. Petersburg), Prof. Oehrwall (Upsala), Prof. Kocher (Bern), Prof. Prévos. (Geneva), Prof. Metzner (Basle), Prof. Sahli (Bern), Drt Billings (New York), Prof. Lombard (Ann Arbor, Michigan). Dr. E. Dupuy (Paris), Prof. H. C. Wood (Philadelphia), Prof. Wilson (Cairo), Prof. Fano (Florence), Prof. Peters (Toronto), and Prof. Golgi (Pavia).

NOTES.

THE recent meeting of the American Association at Boston was one of the largest and most successful in the history of the Association, the attendance numbering nearly one thousand members, representing almost every State in the Union. More than four hundred papers were read and discussed in the various sections, and a large proportion of them were of a very high order. The address of the retiring president, upon some points in theoretical chemistry, was referred to in last week's NATURE. Prof. Putnam, the new president, also delivered an address, and the following addresses were given by the sectional presidents:—Section A (Mathematics and Astronomy), development of astronomical photography, Prof. E. E. Barnard. Section B (Physics), on the perception of light and colour, Prof. F. P. Whitman. Section C (Chemistry), the electric current in organic chemistry, Prof. Smith. Section E (Geology and Geography), glacial geology in America, Prof. H. L. Fairchild. Section F (Zoology), a half-century of evolution with special reference to the effects of geological changes on animal life, Prof. A. S. Packard. Section G (Botany), the conception of species as affected by recent investigations on fungi, Prof. W. G. Farlow. Section H (Anthropology), the advance of psychology, Prof. Cattell. Section I (Economic Science and Statistics), the historic method in economics, Mr. Archibald Blue. The following officers were elected for the ensuing year:—President: Mr. Edward Orton, President of

Ohio State University. General Secretary: Prof. F. Bedell. Secretary of the Council: Mr. Charles Baskerville. Treasurer: Prof. R. S. Woodward. Vice-Presidents: Section A, Prof. Alexander MacFarlane; Section B, Prof. Elihu Thomson; Section C, Prof. F. P. Venable; Section D, Prof. Storm Bull; Section E, Mr. J. F. Whiteaves; Section F, Prof. Simon H. Gage; Section G, Prof. Charles R. Barnes; Section H, Mr. Thomas Wilson; Section I, Mr. Marcus Benjamin. Next year's meeting will be held at Columbus, Ohio.

THE tenth Congress of Russian Naturalists and Physicians was opened at Kieff on September 3, with an attendance of nearly 1500 members, under the presidency of Prof. N. A. Bunge. The presidents of the different sections were the following professors: Mathematics, V. P. Ermakoff; sub-sections of Mechanics, G. K. Susloff; Astronomy, M. T. H. Khandrikoff; Physics, N. N. Schiller; sub-section of Aeronautics, N. E. Zhukovsky; Chemistry, N. A. Bunge; Mineralogy and Geology, K. M. Feofilaktoff; Botany, O. K. Baranetsky; Zoology, N. V. Bobretsky; Anatomy, Physiology, and Medical Science, M. A. Tikhomiroff; Geography and Anthropology, V. B. Antonovich; Agriculture, S. M. Bogdanoff; and Hygiene, V. D. Orloff. Two papers were read at the first general meeting: one by Prof. Bugaeff, on the philosophical purports of mathematics; and the other by Prof. Mendeléeff, on the oscillations of the balance.

PROF. KOCH, accompanied by several assistants, has gone to Italy for the purpose of continuing his researches on malaria. The Italian university laboratories have been placed at his disposal by the Government, which will do everything to facilitate his work. On leaving Italy he will proceed to Greece. This first journey will be of a preliminary character, and will be finished within three months. Afterwards he will visit the fever districts in East Africa, India, and New Guinea, and will be absent there for about two years. The expenses of the expedition will be defrayed by the German Government. Colonial medical officers before going to the tropics will attend courses of instruction at the Institute for Infectious Diseases, in order to be trained in the diagnosis and treatment of tropical diseases under the special supervision of Prof. Koch and his assistants.

PROF. EDWARD S. MORSE has been decorated by the Emperor of Japan with the Order of the Third Class of the Rising Sun. The Order was accompanied by a diploma, the translation of which is as follows:—"His Majesty, the Emperor, has graciously been pleased to confer upon you this Order in recognition of your signal service while you were in the faculty of science in the Imperial University in Tokio, and also in opening in our country the way for zoological, ethnological, and anthropological science, and in establishing the institutions for the same."

ACCORDING to *Science*, the New York Fisheries, Game and Forest Commission proposes to purchase about 50,000 acres of land in the Catskills. The State already owns some 56,212 acres. The Commission reports that deer are rapidly increasing in the Catskills, it being estimated that the forty-four animals turned loose about a year ago have increased to 150, and that there will be between 400 and 500 at the expiration of the five-year period during which their killing is prohibited.

THE *British Medical Journal* states that the second Anatomical Institute of the Berlin University has been reorganised, and is in future to be called the "Anatomical-Biological Institute." As will have been gathered from the name, the Institute will be devoted to work on the borderland of anatomy and physiology. It has three departments—one for histological-biological research, one for embryological-biological work, and one for comparative anatomy.

THE twenty-fifth Congress of the German Society of Public Hygiene is at the present time being held in Cologne. Among the subjects announced for discussion are Imperial legislation on the measures necessary for combating diseases dangerous to the community, public hygiene in railway traffic, and regular supervision of private living houses, and its organisation on the part of the authorities.

THE Indiana (U.S.A.) State Board of Health has officially recommended cremation.

A BRONZE statue is to be erected in Philadelphia in memory of the late Dr. William Pepper.

THE Department of Science and Art has received information, through the Foreign Office, that a horticultural exhibition will be held at St. Petersburg in May 1899.

A COMMITTEE, consisting of Prof. Pickering, President Mendenhall and Prof. Woodward, has been appointed by the Council of the American Association "to increase the efficiency of the Naval Observatory."

PROF. LAWRENCE BRUNER, of the University of Nebraska, is making experiments to determine the methods that might be used to spread among American native species a locust disease studied by him in South Africa last year.

NEWS of a late cuckoo has been received from Mrs. E. Hubbard, Kew. On Thursday, September 1, at 6 a.m., and again on Saturday, September 3, at an earlier hour, Mrs. Hubbard states that she heard a cuckoo repeating his summer call several times. But she did not see the cuckoo.

FOR a long time the Franklin Institute have been publishing the announcement that the Boyden premium of one thousand dollars would be awarded to "any resident of North America who shall determine by experiment whether all rays of light, and other physical rays, are or are not transmitted with the same velocity." The problem has now been more specifically defined by the Board of Managers, as follows:—"Whether or not all rays in the spectrum known at the time the offer was made, namely, March 23, 1859, and comprised between the lowest frequency known thermal rays in the infra-red, and the highest frequency known rays in the ultra-violet, which, in the opinion of the Committee, lie between the approximate frequencies of 2×10^{14} double vibrations per second in the infra-red, and 8×10^{14} in the ultra-violet, travel through free space with the same velocity."

AT the recent meeting of the French Association for the Advancement of Science, the Section of Hygiene, at the suggestion of M. Nicolas, passed a resolution pointing out that the conveyance of tuberculosis by inhalation is only one of the modes of infection, and that a larger part in the diffusion of the disease is played by contagion through the alimentary canal, as proved experimentally and clinically, and urging the necessity of taking adequate measures to ensure the sterilisation and harmlessness of articles of food. The Section expressed the opinion that it is desirable in addition to take measures to suppress, or at least diminish, the causes of weakening of the constitution which make it fall an easy prey to the disease—overstrain, confined air, overcrowding, and unhealthiness of dwellings. In every dwelling a sufficient cubic space should be allowed in proportion to the number of the inmates, and all apartments must be freely ventilated and exposed to the sunlight; it is also necessary that low-built houses should be furnished with large courts to ensure perfect aeration. In this respect the English cottage system represents the ideal which should be aimed at. The Section further urged that the widest possible publicity should be given to the modern doctrines as to the contagious

nature of tuberculosis and its prophylaxis; this should be done by means of public lectures, and also by the moral influence which medical men can exercise in their own sphere. The curability of the disease should also be strongly insisted upon.

THE occasions on which an original subscriber's copy of the complete set of John Gould's ornithological works comes under the hammer are exceedingly rare. Last week, however, says the *Athenæum*, such a series occurred at the sale of the library of the late Edmund Coulthurst, of Streatham Lodge, Lower Streatham. Of the forty-four volumes, thirty-six were bound in green morocco and the remainder were in parts. The series comprised the following: "Birds of Australia," and supplement; "Birds of Europe," "Birds of Great Britain," "Mammals of Australia," "Trochilidæ," or humming-birds, with supplement; "Birds of the Himalayan Mountains," monographs of the Odontophorinæ, or partridges of America; of the Ramphastidæ, or family of toucans; of the Trogonidæ, or family of trogons; and of the Macropodidæ, or kangaroos; "Birds of Asia," and the "Birds of New Guinea." The prices of all these works at auction vary from time to time, but during the past two or three seasons a set of ordinary copies (that is to say, not of the original subscribers' edition) have realised an aggregate of rather more than 373*l*. The published price of a set, including second editions, is now about 670*l*. Mr. Coulthurst's very fine set realised the total amount of 430*l*.

WE learn from *Literature* that a remarkable discovery has recently been made in Dumbartonshire on the shores of the river Clyde—viz. an undoubted crannog, or dwelling on piles. It is about a mile east of Dumbarton Castle, is below high-water mark, and about fifty yards from the river at low tide. The circumference of the crannog is 184 feet. The outer circle is composed of piles of oak, sharpened by stone axes at the lower end, and below the mud still quite fresh. The transverse beams and pavements are of wood—willow, elder and oak, the smaller branches of fir, birch and hazel, with bracken, moss and chips. The refuse-mound extends about twelve feet outside, and in this have been found the bones of stags, cows, sheep, &c., together with evidences of fire, also numerous fire-stones, and a hone or whet-stone. Near the causeway a canoe, 37 feet long and 48 inches beam, was found, hollowed out of a single oak tree. The credit of the discovery is due to Mr. W. A. Donnelly, a local antiquary. It is a unique discovery, because this is the first example of a crannog situated on tidal waters, and because only flint and bone implements have yet been discovered, which dates it back into the Neolithic Age.

THE Deutsche Seewarte has published a sixteenth large quarto volume (xxvi + 193 pp.) containing the results of meteorological observations of German and Dutch ships for one-degree squares of the North Atlantic Ocean. The present volume embraces the area known as the ten-degree square, No. 115, and includes in a tabular form all the observations collected for a number of years between latitude 30°-40° N. and 60°-70° W. In this case the whole of the observations were made on German ships, as there were no Dutch vessels in the district. The form adopted is very convenient, as other countries can, if they choose, add their own observations to those now given, and thus enhance the value of the results. This important work forms part of a regular plan, in which the Seewarte undertook to discuss that part of the North Atlantic lying between latitude 50° and 20°, for each month of the year. It adjoins the district of the nine tropical ten-degree squares lying between latitude 20° N. and 10° S., and longitude 10° and 40° W., the discussion of which was undertaken by the Meteorological Council and published in the year 1876. The data afford trustworthy information for captains of vessels navigating that ocean, and for those persons dealing with the physical geography of the sea.

AN interesting note on the introduction of aluminium into India, as a substitute for copper and brass in the manufacture of cooking pots and other utensils, appears in *Engineering*. The initiative in the matter appears to have been taken by Prof. Chatterton, of the Madras University, who, in November last, took with him from England a small quantity of aluminium, and commenced experiments with it at the metal-working classes of the School of Arts, Madras, of which he has the direction. A little later a small factory was equipped, and the products were so favourably received that the output in the course of five months amounted to considerably over a ton per month. This result is somewhat surprising, in view of the intense conservatism of the Indian peoples. Nevertheless, this latter feeling, though it has not resented very actively a change of material, is still strongly displayed, in so far as the forms and finish of these cooking vessels are concerned. The shapes of the new vessel must, to be acceptable, be exactly the same as the old; and the matter is somewhat complicated, as these traditional shapes differ in every district. Further, the vessels must be all hand-made, as drawn or spun work is disliked, in spite of its greater cheapness. An attempt to meet the native wishes in this matter, whilst at the same time reducing the cost of the utensils, is now being made. A drawing press is used to accomplish the initial stages of the work, which is then finished by hand. Some of the Indian workmen are said to be now very skilful in the use of the new material, and efforts are being made to establish similar factories elsewhere.

THE *Lancet* gives the following particulars of the United States steamship, the *Protector*, which, it is stated, is the first vessel in the world to be equipped solely for the purpose of disinfection. On the deck of the vessel, which is about 80 feet long, is a structure fitted for bathrooms. It is intended that soldiers shall come on board, take a bath, and give up their clothing, receiving new clothes in exchange. The old clothing will then be taken below, thoroughly sterilised, and then returned to the owner. In the bow of the boat are a sulphur furnace, combustion chambers, and a fan for disinfecting vessels. In the middle are a sterilising chamber and a formaldehyde generator. A boiler and a water-heater are near the stern. The sulphur furnace will be used for disinfecting vessels. The hatches of the vessel to be treated will be battened down, and piping carried from the *Protector* to the hold of the vessel. Through this tubing sulphur fumes will be pumped by the fan in the *Protector*. Air is drawn into and through the sulphur furnace, baffle-plates being so placed as to thoroughly mix air and sulphur fumes, a fairly perfect combustion being thus obtained. The sterilising apparatus consists of a cylinder, a chamber, and an exhauster. The chamber is of iron, and though open at both ends it can be hermetically sealed. The exhauster consists of a steam-jet for removing air from the chamber. The generator is a copper cylinder divided vertically into two parts, a steam coil being placed in each part. The clothes to be sterilised are placed in the chamber, the air in which is removed by means of the steam-jet exhauster. Formaline is placed in part of the generator and steam admitted to the coil, and when sufficient heat has been thus applied to generate the required amount of formaldehyde gas the gas is admitted to the chamber. At the end of half an hour ammonia, placed in the other part of the generator and similarly heated, is admitted to the chamber. This neutralises the formaldehyde, and the clothes are removed and returned to the owners.

FROM Prof. Augusto Righi we have received a reprint of his description of a new apparatus for representing the resultant of two pendulum oscillations in the same straight line. One of the two pendulums used consists of a leaden ring containing a cup filled with white sand, suspended by cords,

and the length of this pendulum can be altered by raising or lowering a sliding piece. The second pendulum carries a table on which a piece of black paper is slowly drawn by clockwork in a direction perpendicular to the plane of vibration, and the sand escaping from a hole in the cup of the upper pendulum traces out the vibration curves on the paper, the thickness of the line of sand being greatest where the motion is slowest and *vice versa*. By an electric arrangement the two pendulums can be started with any required difference of phase. The use of sand is not very convenient if the drawings are to be preserved, but they can be photographed, and the figures given by Prof. Righi show distinctly the variations of thickness of the sand with the speed. Prof. Righi's paper forms the subject of a communication to the Bologna Academy of Sciences.

OUR present knowledge of the theory of errors receives an interesting addition at the hands of M. Charles Lagrange in the form of a contribution to the *Bulletin de l'Académie royale de Belgique* (vol. xxxv. part 6). Without going into details of a purely mathematical nature, certain of M. Lagrange's conclusions appear sufficiently important to be worth noticing. In taking the arithmetic mean of a number of observations as the most probable value of the observed quantity, common sense suggests that any observations differing very widely from the rest should be left out of count as being purely accidental, and thus likely to vitiate the result. But as it is impossible to draw the line from theoretical considerations between values retained and values omitted, any such omission would necessarily be unjustifiable. This discrepancy between theory and common sense is, to a large extent, reconciled by M. Lagrange's "theory of recurring means." According to this theory, the *weight* to be assigned to any observation is inversely proportional to the square of the error of the observed value relative to the most probable value. Taking, then, the arithmetic mean of a number of observations as a first approximation to the most probable value, the errors relative to this mean determine the weights of the various observations. The weighted mean is then taken as a second approximation to the most probable value. This mean determines a fresh series of weights to be assigned to the observations by which a new weighted mean—the third approximation to the most probable value—is found, and so on to any required degree of approximation. These successive means are called by M. Lagrange "recurring means," and by their use the effects of sporadic errors are, to all practical purposes, eliminated, since the weight assigned to the corresponding observations soon becomes relatively small.

IN the latter half of 1895, a new fish hatchery, under the direction of the United States Fish Commission, was established at a small place called Ten Pound Island in Massachusetts Bay, and in the autumn of 1897 there were hatched and "planted" in the waters of the bay over 60,000,000 small cod fry. At the end of the year some 30,000,000 eggs were still in process of hatching. The number of eggs successfully hatched is much greater in the early than in the latter half of the season, when only 54 per cent. of the eggs are successfully hatched in proportion to the first half. From the *Journal* of the Society of Arts, we learn that Sir D. Colnaghi, H.M. Consul at Boston, says that men proficient in stripping a codfish of its spawn are put on board the shore fishing boats which land their catch at Kittery, Maine, in the proportion of one man to each boat. As the fish are taken alive from the water, they are inspected and, if suitable for the purpose, are stripped of their eggs, which are placed in jars and forwarded to Gloucester, Massachusetts. More or less, the eggs are injured in transit, but it has been, on the whole, advantageous to forward them to Ten Pound Island, where good results in hatching have been obtained. Nature is followed as far as possible in the hatching process, the eggs being placed in perforated boxes and sea water direct from the ocean being continuously pumped through the boxes, so that the temperature may be as nearly as possible the same as that of the ocean. As soon as the eggs are hatched, the small fish are planted or released in the waters of Massachusetts Bay and have to rely on themselves, the same as the fry spawned in the open ocean. Ipswich Bay, Massachusetts, and the contiguous waters appear to be a favourite spawning ground for codfish, and the artificially-hatched fry, therefore, mingle with the many others of their kind and take the same chances in the struggle for existence. There are, of course, no data on which to base any calculation as to the percentage of artificially-hatched fry which reach maturity, but the officers of the Fish Commission claim that the fish released by them are hardier in proportion, the weaker ones having been sifted and the stronger alone planted. As regards the success of the hatchery, it is proved that since the Fish Commission commenced operations the supply has certainly increased. Some years ago so few codfish were taken by the shore fishermen, that the fishery had become unremunerative, but at the present time fish are fairly abundant, and the fishery gives employment to a good number of men, who themselves admit that the hatchery operations have been successful. After the codfish season is over, the officials turn their attention to lobster hatching, and the same operations are gone through as with the codfish.

A NUMBER of interesting facts concerning illuminated buoys are brought together in an article in the *Times* of September 6. From this description it appears that Mr. J. Pintsch was the first to successfully construct a buoy to show a light at night. The light is produced by gas, which is stored in a compressed state in the body of the buoy, and passed up to the burner through a small pipe controlled by an ingenious automatic regulator which causes the gas to be emitted at a low and uniform pressure. Stored up in the buoy in a compressed state—the pressure being equivalent to that of about five atmospheres—and passing out very slowly, the gas will last some two or three months burning always by day and by night. Coal gas cannot be used for this purpose because compression robs it of more than half of its illuminating power, while in the case of oil gas the loss is so slight that it is practically immaterial. The light itself is surrounded by a small lenticular arrangement intended to enhance the illuminating power, enclosed in a glass lantern fixed about eight or ten feet above the sea level, and in clear weather is visible five miles. At first it was found desirable to use only a fixed light, but more recent experience has shown that it is possible by suitable mechanism to show a quick flashing light and an occulting light, these variations being extended by the use of coloured glass.

RECOGNISING the great value to navigation of lighted buoys which could be depended upon, the Elder Brethren of the Trinity House (we learn from the article referred to in the foregoing note) have done much to encourage the development of the system in this country by placing gas-lighted buoys at many important points in the channels at the entrances of the Thames, in the Solent, and elsewhere. These guides to navigation have also been established by the Scottish Lighthouse Board, the local authorities for the Mersey, the Clyde, the Tees, the Ribble, King's Lynn, and sundry other seaports, and now on the coasts of the United Kingdom there are close upon one hundred gas-lighted buoys in position. In the Suez Canal, in Canadian and Australian waters, these buoys are in use. In America, also, a considerable number are employed; but the United States Lighthouse Board has, also, some electrically-lighted buoys in Gedney's Channel approach to New York. These buoys are connected to each other and with the shore by

submarine cables, through which the electricity, generated on shore, is transmitted to the buoys. In France the lighting of buoys by means of gas has been largely adopted of late years, the lighthouse authorities of that country having taken up the matter with their usual vigour, and placed such buoys in many parts of their coasts. In Germany, Denmark, Russia, Holland, and Italy numerous gas-lighted buoys have replaced unlighted ones, and, in fact, the system is coming into use in all parts of the world. It may truly be said that the development of this system of illuminated buoys is the most important improvement in our coast-marking arrangements that has taken place in the last five and twenty years.

THE additions to the Zoological Society's Gardens during the past week include a Chacma Baboon (*Cynocephalus porcarius*, ♀) from South Africa, two Egyptian Geese (*Chenalopex agyptiacus*) from Africa, presented by Mr. J. E. Matcham; eleven Long-eared Bats (*Plecotus auritus*), European, presented by Mr. F. Cane; a Stanley Chevrotain (*Tragulus stanleyanus*, ♂) from Java, presented by Miss Norah F. L. Briggs; two Hawk-billed Turtles (*Chelone imbricata*) from the West Indies, presented by Mr. H. Skinner; a Leopard (*Felis pardus*) from Japan, a Kinkajou (*Cercoleptes caudivolvulus*, ♂), two Spotted Cavies (*Cœlogenys paca*), a Ring-tailed Coati (*Nasua rufa*), a Plumbeous Snake (*Oxyrhopus clælia*) from South America, a Punctated Agouti (*Dasyprocta punctata*), six Spiny-tailed Iguanas (*Ctenosaura acanthura*) from Central America, a Festive Amazon (*Chrysotis festiva*) from Guiana, a Nose-horned Viper (*Bitis nasicornis*) from West Africa, deposited; a Kinkajou (*Cercoleptes caudivolvulus*) from South America, purchased.

OUR ASTRONOMICAL COLUMN.

COMET TEMPEL 1866?—A telegram from Kiel, dated September 14, tells us that Herr Pechuele discovered a comet on September 13, 15h. 47·5m., at Copenhagen, having R.A. 6h. 10m. 8s. and Dec. + 8° 55′ 40″. This, as the telegram informs us, is probably Tempel's comet of 1866.

THE VARIATION OF LATITUDE AT TOKYO.—In the *Publications of the Earthquake Investigation Committee* (Nos. I. and II.), Mr. H. Kimura gives a preliminary report of his investigation of the variation of latitude at the place of observation, namely Tokyo. The first series of observations extended from July 21, 1895, to June 26, 1896, and the second from September 13, 1896, to September 25, 1897. The instrument employed was a Wanschaff's zenith telescope of 81 mm. aperture and 100 cm. focal length, and Talcott's method of observation was used. The climatic conditions at the station were not always quite favourable, but generally the weather was dry and clear in winter, and misty and cloudy in summer. Mr. Kimura, besides giving the means and monthly means of observations, describes graphically the variation as observed by him. In 1895 the maximum occurred towards the end of November, and amounted to about 16″·835, the following minimum being reached about the end of June 1896. As a break occurred in the observations at this period, the exact time of occurrence cannot be accurately stated, but its amount was 16″·51 approximately. The time of the next maximum cannot be gathered from the curve, as the latter is very flat at maximum; its value is about 16″·865. The following minimum is sharply marked, and occurred about August 12, 1897, amounting to 16″·39.

When the whole subject of the variation of latitude comes to be studied, these observations should be found very useful.

MOTION OF STARS IN THE LINE OF SIGHT.—M. Deslandres contributes to the *Bulletin* of the Astronomical Society of France (September) a short article on the photography of the motion of stars in the line of sight by means of the spectroscope, and accompanies it by some excellent phototypes from four of his valuable negatives. Each stellar spectrum is compared with the spectrum of some terrestrial substance. Thus Capella, a solar star, is compared chiefly with iron, calcium, manganese, &c., its radial velocity being deduced as +43·8 kilometres per second. The velocities of the components of β Aurigæ were found to be −84·5 and +97 kilometres per second; while Sirius and γ Pegasi were observed to have velocities of +18·33 and −2·78 kilometres per second respectively.

M. Deslandres remarks that the observatories of Paris, Potsdam, and Pulkova are the only ones that are organised in a proper manner for this kind of work; but the time will come when these stellar motions will be determined with the regularity of meridian observations at the present time.

THE AUGUST METEORS.—The fall of meteors in August was greater than was anticipated, and was fortunately observed at a number of stations. In the *Bulletin de la Société Astronomique de France* for September will be found several accounts of the observations made in France, notably those made at the Juvisy Observatory by M. Antoniadi, and at Listrac by M. Henri Pineau. In both of these accounts the observations have been plotted on star charts, and show well the abundance of the Perseids; but, unfortunately, no mention is made of the deduced radiant point, so that we are unable to see whether any variation has occurred from the previously observed positions.

DRAWINGS OF THE MILKY WAY.—We are asked to announce that a limited number of copies of Dr. O. Boeddicker's pictures of the Milky Way, lithographed by Mr. W. H. Wesley, can now be obtained on payment of five shillings a set to defray postage and other expenses. The drawings show the Milky Way from the North Pole to 10° of South Declination, as seen by the unaided eye. They were made by Dr. Boeddicker, at the Earl of Rosse's Observatory, Birr Castle, in the years 1884–89, and are full of delicate detail. Applications for copies should be sent to Mr. R. J. Sheppard, Stationer, Parsonstown, Ireland.

THE AURORA OF SEPTEMBER 9.

THE evening of Friday, September 9, was characterised by an exceedingly brilliant auroral display, which appears to have attracted considerable attention. Immediately after dark, about 7 p.m., the main arc was distinctly seen above the northern horizon, and as the sky gradually became less luminous, numerous streamers of varying brightness made their appearance. At Kensington, where the ground lights were somewhat glaring, the main arc appeared simple, and not made up of several parallel arches, as is often the case with bright auroræ. Its extent would be about 60° in azimuth, the upper limit of the arch being about 20°. This was continuously very bright throughout the evening, and the maximum brightness was very conspicuously "*magnetic*," and not "*geographical*" north. The intensity, number, and extent of the streamers varied considerably, and in no case did any particular streamer persist more than about ten minutes. At one time, about 8 p.m., two large streamers were noticed which extended much beyond the zenith, having a length of about 130°, and frequently the whole northern arc was bounded by radiating glows extending about 40° or 50°. No corona was seen during the display, but several times a set of large streamers, in breaking up, formed masses of luminous auroral clouds which were scattered on the whole celestial hemisphere.

The only colour observed was pale violet, with, perhaps, a tinge of green, but no trace of ruddiness was at any time visible.

The dark patches frequently seen in previous auroræ bounding the northern horizon under the main arc were very distinct, and although resembling ordinary clouds in form, were evidently connected with the disturbance.

Observations with the spectroscope showed the greenish-yellow line with ease, and the spectrum was bright enough to exhibit several bands extending through the green blue and violet, a dark interval at the extreme violet end reminding one forcibly of the carbon band spectrum at this region. Several attempts were made to photograph the spectrum, exposures of thirty minutes, 1½ hours and 2½ hours respectively being given, but no spectrum was visible on development.

Several letters have reached us with reference to recent auroral displays. Mr. D. Pidgeon, writing from Leatherhead, Surrey, says:—"There was a bright aurora here on the 7th, 9th and 10th. The display on the 9th was magnificent, streamer after streamer shooting across the sky from 9 o'clock to 10.30. At a later hour the luminosity became localised in a long low arch, which stretched for many degrees east and west of north. Only stars of the first magnitude could be seen at 10 o'clock in a quite clear sky, the light of which was such as to make reading easy." Mr. W. F. Spear observed the display at Cricklewood, London, on September 9, at 8.15, and he remarks with reference to it:—

"Except in extent and duration, the phenomenon differed in a way from what I have frequently seen on clear cold evenings when wintering in the north of Norway, beyond the Arctic circle." Mr. F. C. Constable observed the display at Fambridge Station, Essex, at 8.45 p.m. on Friday, September 9. He writes:—"I saw two colourless streamers of light running from a point to the west of north up nearly to the zenith—one covered the north star, the other to the west. They disappeared in about a minute. This morning the Fambridge station-master told me that late in the evening of Friday, about the same time, many streamers were seen, and the telegraph would not work, the bells ringing of themselves."

In connection with the recent display it is interesting to note that the unusually large spot which came over the eastern limb of the sun on Saturday, September 3, was on the central meridian of the sun's disc on Friday the 9th, at about the time the aurora was at its maximum. And still further, the automatic recording instrument for magnetic declination in the Physics Department at South Kensington showed a large disturbance the same evening. From the photographic record it appears that the disturbance began about 7.30 p.m., and in 15 minutes reached a value of 30′ of arc; by 8 p.m. the declination was normal again, but immediately afterwards the needle travelled on in the opposite direction to the first displacement, and reached a second maximum eastwards about 8.15. By 8.30 the needle had again assumed its normal position, and no further disturbance, other than the usual diurnal one, has yet been recorded. Thus the declination magnet was deflected over 1° in the hour from 7.30–8.30 p.m. This leaves little doubt as to the definite connection between the position of the spot on the solar disc, the magnetic variation, and the aurora. Confirmation of this observation will be found in the announcement made by Dr. Chree, in our correspondence columns, that a conspicuous magnetic storm was recorded at the Kew Observatory while the aurora was in progress.

In addition to the displays referred to in the foregoing, a very bright aurora was recorded by several observers on the previous Friday evening, September 2, on which night the spot would be coming round the eastern limb, and a search back over the magnetic records for that evening shows that a disturbance was photographed then also. With these two coincidences it will be interesting to see if a third aurora and another magnetic disturbance accompany the passage of this large spot over the western limb, which will be some time during to-day, September 15.

Accounts have been received from several parts of the kingdom of difficulties experienced in the transmission of telegraphic and telephonic messages on Friday last, and this is a well-known sign of considerable magnetic disturbance.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

AT the New Mexico Agricultural College and Experiment Station, Prof. C. H. T. Townsend has been appointed bio-geographer and systematic entomologist, E. O. Wooten professor of botany, and T. D. A. Cockerell professor of entomology, in addition to being station entomologist.

THE following appointments are announced:—T. Proctor Hall to be professor of physics in Kansas City University; Robert B. Owens, late of the University of Nebraska, to be professor of electrical engineering in McGill University, Montreal; Dr. Mark V. Slingerland, of Cornell University, to be State entomologist for New York, in the place of the late Dr. J. A. Lintner.

DETAILED particulars with regard to the mode of entering the medical profession, the degrees and diplomas granted by the various universities and corporations, and the institutions where medical students are trained, are given in the educational number of the *British Medical Journal* (August 27), and the students' number of the *Lancet* (September 3). These numbers should be seen by all students who are about to commence their medical studies, and by parents who contemplate entering their sons in the medical profession. Information as to schools of pharmacy, medicine, dentistry, and veterinary-surgery will be found in the *Chemist and Druggist* of September 3, and details as to the staff, curriculum, and fees, in universities, colleges, and other institutions, are given in the *Chemical News* of September 2.

SCIENTIFIC SERIALS.

Symons's Monthly Meteorological Magazine, August.—British local meteorological publications. This is a useful list, referring mostly to the year 1897, of books and pamphlets containing observations made in the British Islands, and arranged according to counties. Leaving out of consideration official publications such as issued by the Meteorological Office on the part of the Government, or those emanating from private institutions, such as the Royal and Scottish Meteorological Societies, one is struck by the numerous independent stations at which attention is paid to the subject in question, some of which might advantageously connect themselves with the Central Office. In the majority of counties the Medical Officers of Health publish valuable observations in their reports; in addition to these, we can only refer to a very few of the private organisations which publish observations for a number of stations. For Surrey and Kent, the Croydon Natural History Club prints daily rainfall values for about seventy stations. Similarly, in Hertfordshire, the Natural History Society publishes rainfall values for several stations, and there is also a county organisation in Northampton. In Norfolk, the Rev. Canon Du Port has published monthly rainfall values at about forty stations for more than a quarter of a century. The rainfall of Dorset has been discussed with great care by Mr. H. Storks Eaton, and tabulated results for many stations are published in Gloucester, Hereford, Lincolnshire (fifty stations), Nottingham, Lancashire, and many others.—Results of meteorological observations at Camden-square (N.W. London) for July for forty years, 1858–97. The highest maximum temperature for the period was 94°·6 (July 15, 1881), and the mean of all the highest readings was 85°·2; this year the maximum for the month was 82°·9. The average rainfall is 2·39 inches; the fall for July this year only amounted to 1·09 inches.

Annalen der Physik und Chemie, No. 7.—Questions concerning the motion of translation of the luminiferous ether, by W. Wien. If the ether is immovable, a thin plate possessing different radiating powers for heat rays on its two faces, could put itself into motion by virtue of the difference of pressure on the two faces. It is possible that the ether is carried along by the earth, but not by bodies of small mass.—The behaviour of kathode rays parallel to the electric force, by P. Lenard. When a beam of kathode rays is sent through a perforated condenser in the direction of the lines of electric force, its velocity is retarded, and it is more subject to deflection by a magnetic or electrostatic field.—The dark kathode space, by A. Wehnelt. The resistance of the dark space to electric discharge is considerable. When the discharge proceeds through the dark space only, it has a disruptive character, as if the dark space were a dielectric like paraffin oil. This can be shown by introducing the anode into the dark space itself. Waves proceed from the discharge tube, and may be placed in evidence by means of a coherer.—Microscopic observations of coherers, by L. Arons. The author's coherers were made by cutting a fine line across a thin strip of tinfoil stuck on glass, laying a little metallic powder across it, adding a drop of Canada balsam, and covering with a cover-glass. The newly prepared coherers had an infinite resistance. The impact of electric waves produced full contact, accompanied by a commotion of the particles and a play of sparks, as seen under the microscope.—Electrolytic solution of platinum and gold, by M. Margules. Platinum may be dissolved in acids or caustic alkalis by sending the secondary current from an induction coil through an electrolytic cell with platinum electrodes. Gold is similarly dissolved, but its solutions are very sensitive to light.—Theoretical derivation of the constant of Dulong and Petit's law, by H. Staigmüller. The derivation is based upon the assumption that the temperature of a solid is determined by the mean kinetic energy of the atom oscillating about a position of equilibrium.

Memoirs of the St. Petersburg Society of Naturalists: Zoology and Physiology, vol. xxviii. No. 2.—Researches into the history of development of Cephalopoda; and biological observations on Lamellibranchiata, the formation of pigment in *Mytilus*, and the autotomy of the syphons in *Solen* and *Solecurtus*, by V. A. Fausseck. A detailed work, 270 pages, with 8 plates and figures in the text.—Vol. xxviii. No. 3. The changes of irritability of a muscle under the influence of a direct current, by Prof. V. A. Kovalevsky (published in *Comptes rendus*).—Ornithological researches in the Government of Pskov, by K. M. Deryughin. Based upon the author's four

years' researches and collections, as also upon the collections of Profs. Zarudnyi and Karéeff. The author distinguishes between the fauna of two great lakes, the fields (very poor), and the forest region. Full lists of birds in these three regions are given.—On the wandering cells of the bowels of the Sea-urchins, by Prof. C. Saint-Hilaire. A detailed work of 170 pages, with 2 coloured plates (136 figures). Its important conclusions, especially as regards the clear distinction between the granular cells and the phagocyte cells, and the functions of the former, are fully summed up by the author, in German.

Bulletin de l'Académie des Sciences de St. Pétersbourg, September 1897, tome vii. No. 2.—On Auerbachite and the rock which contains it, by P. Ereméeff (Russian). A closer study of this mineral shows that it cannot be considered as a separate species, or even as a variety or a pseudomorph of well-known minerals.—The Gasteropods of the Baltic Lower Silurian, by Ernst Koken (German). A detailed monograph, with forty-three woodcuts; it is, however, only a preliminary report on the author's larger work upon which he was engaged for the last ten years. Over 200 species are mentioned, and more than one-half of them are new.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 5.—M. Wolf in the chair.—Observations on the planet Witt (1898, August 14), made at the Observatory of Algiers, by M. F. Sy. Positions of the planet are given for August 16, 17 and 18.—Observations on the same planet made at the Observatory of Besançon, by M. Gruey. Measurements of the planet's position on the nights of August 17 to 20, and 25 to 27 are given. The planet is about the eleventh magnitude.—On a silicide of tungsten, by M. E. Vigouroux. A mixture of silicon and oxide of tungsten on heating in the electric furnace gives a crystalline mass containing the new silicide, metallic tungsten, silica, and carbon silicide. The tungsten is first removed by making the ingot the positive pole in a 10 per cent. solution of hydrochloric acid, and passing an electric current. The crystalline residue, after treating successively with *aqua regia*, ammonia, hydrofluoric acid, and methylene iodide is the pure silicide W_2Si_3. The crystals are steel-grey in colour, very heavy (density 10·9), and are attacked by chlorine at a dull red heat.—On *Arhinolemur*, a genus found in the Parana tertiaries, representing a new type of mammifer, by M. Ameghino. An examination of the skull of a small tertiary mammal, found by M. Scalabrini in the neighbourhood of Parana, leads to the conclusion that the form does not correspond with that of any known living or fossil mammal. The shape of the incisors, the separation of the mandibular branches, the widened form of the cranium, the arrangement of the orbits suggest a form allied to the Lemuridæ; but the oblique curve of the intermaxillaries, as well as the general *facies*, appears to show affinities with the bats. Other features, amongst which may be mentioned the complete obliteration of the nasal opening, have not been met with either in mammals or reptiles.—On the anatomical structure of the stem of the beet-root, by M. Georges Fron. The thickening of the stem is produced, not by the formation of generating layers as in the root, but by the displacement of one single generating layer towards the exterior. This layer, at first of normal origin, becomes partly normal and partly pericyclic, and finally completely pericyclic.—On the toxicity of copper salts with regard to the higher vegetables, by M. Henri Coupin. Experiments were made with solutions of various salts of copper (bromide, chloride, sulphate, acetate, and nitrate) upon young wheat plants. All the salts studied had very nearly the same toxic power: a solution of copper sulphate containing only ·0055 per cent. of the salt is sufficient to prevent the germination of wheat, and hence the proposed application of this salt to kill noxious weeds is of very doubtful advantage.—The tufa of the Gaubert (Dordogne), by M. Émile Rivière.

NEW SOUTH WALES.

Linnean Society, July 28.—Mr. Henry Deane, Vice-President, in the chair.—Revision of the Australian *Curculionidæ* belonging to the subfamily *Cryptorhynchides*. Part ii. By Arthur M. Lea. Four new genera are proposed, of which three are founded on species referred by Mr. Pascoe to *Poropterus*; and four genera allied to *Poropterus* are re-described. These comprehend a total of thirty-one species which receive attention, fifteen of them being described as new.—Descriptions of new Mollusca from Victoria. By J. Brazier. Four species referable to the genera *Conus*, *Columbella* (*Mitrella*), *Lucina* (*Codakia*), and *Tellina* (*Strigella*) are described as new. *Hab.*—San Remo.—Notes on some Port Jackson plants. By J. H. Maiden and J. H. Camfield. (*a*) A well-marked variety (*brevistylis*) of *Sprengelia incarnata*, Sm., is described. (*b*) The authors propose to restore *Banksia paludosa*, R.Br. (which had been reduced by Bentham to a variety of *B. integrifolia*) to the rank of a species.—Revision of the genus *Paropsis*. Part iii. By Rev. T. Blackburn. In this paper the author takes in hand the species forming Group vi. of the classification propounded in an earlier paper; and three subgroups are dealt with. In addition to critical remarks and tabulations, descriptions of thirteen new species are given.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Machine Drawing: T. and T. G. Jones, Book 2, Part 1 (J. Heywood).—Durham College of Science, Calendar 1898-99 (A. Reid).—Mathematical Examination Papers: Rev. J. L. Robinson (Rivingtons).—Skertchly's Geology: Dr. J. Monckton, 9th edition (Murby).—The Flora of Donegal: H. C. Hart (Dublin, Sealy).—Photography Annual, 1898 (Iliffe).—Northward over the "Great Ice": R. E. Peary, 2 Vols. (Methuen).—Outlines of the Earth's History: Prof. N. S. Shaler (Heinemann).

PAMPHLETS.—Bourne's Handy Assurance Manual, 1898: W. Schooling (E. Wilson).—Chloroform: Dr. R. Bell (Glasgow, Holmes).—Die Bedeutung der Reize, &c.: Dr. A. Goldscheider (Leipzig, Barth).—Studien über die Protoplasmaströmung bei den Characeen: Dr. G. Hormann (Jena, Fischer).—The Secret of the Poles: H. Campion (Birmingham, White).

SERIALS.—Knowledge, September (Holborn).—Humanitarian, September (Hutchinson).—Fortnightly Review, September (Chapman).—National Review, September (Arnold).—Scribner's Magazine, September (Low).—Physical Review, July (Macmillan).—Bulletin de l'Académie Royale des Sciences, &c., de Belgique, 1898, No. 7 (Bruxelles).—Geographical Journal, September (Stanford).—Journal of Botany, September (West).—Astrophysical Journal, August (Chicago).—Monthly Weather Review, May (Washington).—Records of the Botanical Survey of India, Vol. 1, Nos. 9 and 10 (Calcutta).—Observatory, September (Taylor).—Transactions and Proceedings of the New Zealand Institute, Vol. xxx. (Wellington).—Journal of the Chemical Society, September (Gurney).—Zeitschrift für Wissenschaftliche Zoologie, lxiv. Band, 3 Heft, Register über Band 46-60 (Leipzig, Engelmann).—Physical Society of London, Proceedings, August (Taylor).—Smithsonian Miscellaneous Collections, Vol. xl. (Washington).—Engineering Magazine, September (222 Strand).—Journal of the Franklin Institute, September (Philadelphia).—American Journal of Science, September (New Haven).

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